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AN IMPORTANT PATENT CASE.

What is perhaps one of the most important patent cases, as far as relates to the principle concerned, that has been brought before the courts in recent years is on the calendar of the United States Circuit Court of Appeals, now in session in New York, although the case may not be reached until the March session. The principle is whether in applying to a domestic patent the limitation as to its life through the expiration of a foreign patent, the date of application for the foreign patent shall prevail or the date of its actual issue. During the last ten years there has been a number of decisions on the point by the lower Federal courts, and all maintain that the actual date when the patent was issued should apply, but this is the first time it has been brought before a higher court. A reversal of these decisions would have an enormous importance in every branch of industry, and, among other electrical patents, would extend the life of the Edison microphone and incandescent lamp patents, the latter to 1897.

PRACTICAL EXPEDIENTS.

One of the qualities most conducive to success in practical work is that of devising expedients for accomplishing purposes that otherwise would be left undone through the lack of the usual material or instruments. The article by Mr. Hanchett in another column is devoted to this subject, and in it many practical hints will be found that may come in very usefully when most neeeded. Aside from the direct value of never being at a loss in devising means for attaining an end, there is an indirect value from the effect that such a quality has in increasing consideration for a person's professional qualities among those upon whose good opinion professional success may depend. Where they might not be able to judge as to qualities of much higher value, this, on the contarary, is one that comes within their scope, and for which they are likely to give undue credit, but none the less advantageous. The head of a great engineering school in his address to graduating students always took occasion to impress strongly on their mind the great truth of a saying to the effect that success in life depended not so much upon what one knows as upon what one is thought to know, and, it may be added, the man fertile of expedients is most likely to get most credit for professional knowledge and at the same time is most likely through this quality to really achieve his ends.

THE NOVAK LAMP CASE

While the recent argument in the Novak lamp case before the United States Circuit Court of Appeals contains little that was not brought out on the previous trial, several of the points are enlarged on, and one of the contentions of the Edison attorney—that the expulsion of occluded gases was not a vital part of the Edison patent—received an emphatic denial from Judge Lacombe. Another point of interest which the counsel have made an issue is whether the use of a carbon filament is an invention covered by the Edison patent. The defense claims that there is no patentable novelty in any separate part of the combination upon which the Edison lamp patent rests, and that Edison never ventured to claim the carbon filament, uncombined with other things, as his invention; that he had disclosed the filament principle in his French platinum lamp patent, and that on account of the prior use of carbon in incandescent lamps there could

therefore be no invention in a carbon filament. While the complainants admit, and this seems to be significant, that the employment of an inert gas will reduce blackening of the chamber, they claim that this has long been known, and not only deny that any other benefit accrues from the use of bromine gas, but assert that the efficiency and life of the Novak lamp is reduced, and to such an extent as to more than nullify the benefit derived from less blackening. The Novak counsel, on the other hand, contend that there is great improvement in the two latter respects, as shown by the testimony of their experts and the experience of the public, who, moreover, have been paying a higher price for the Novak lamp on this account. They claim that the bromine atmosphere is not a mere addition to Edison's "nearly perfect vacuum," which means and intends the exclusion of all the gases, not only oxygen and nitrogen, which make up atmospheric air, but other gases as well. While up to a certain point both Edison and Waring proceed together in the exercise of a prior art, they there saparate, Edison adding a genuine vacuum and Waring an inert gas. The one diminishes the gaseous contents from 1-600 of an atmosphere to at least 1-30,000, while the other adds to the gaseous contents of the chambers until they weigh four times what they did before. The question of the expiration of the Edison patent through that of the English patent, on Nov. 10, 1893, is brought up, but as this point as here made has been frequently decided in the negative, that part of the argument seems to have little importance. On the other hand, the point recently decided by Judge Ricks—that by the endorsement of the Edison attorneys of the above date on the patent, it was dedicated to the public after that endorsement—is one of extreme importance, and the view the court will take of it will be awaited with the greatest of interest.

THE ELECTRIC IMPOSTOR.

It might be said that not the least important progress in the electrical field has been the more rapid decline of the electric impostor. But although the number of impostors and the mischief they do is growing less every year, the electrical industry cannot yet congratulate itself on being free from this annoying and injurious parasite. He still turns up every now and then in one form or another, and after fleecing numerous widows of their mites, children of their inheritances and uneducated capitalists of the money which they do not know how to guard, he retires with his easily earned gains, priding himself on his skill as an unscrupulous rascal. We have little sympathy for men and women who encourage such an impostor by subscribing to his worthless stock, but even if they cannot be convinced of their mistake by people who have a real knowledge of the subject, they will do well at least to read over more carefully some of his claims. He usually claims to be "ahead of his time," and as examples of similarly "unfortunate" men, he cites some who made really great inventions which in those early times were pronounced by some to be impossibilities. This favorite claim often has the desired effect on the ignorant and sceptical, but if they will look into those historical cases they will usually find that the knowledge of that time was not sufficient to enable one to really prove the impossibility of those inventions. Before the first steamboat was built there was no knowledge in existence regarding steamboats, and although it may have been said at that time that such a thing was an impossibility, yet it cannot have been anything but a mere opinion. However much there may be yet unknown in the electric science, there are some things which are known definitely and are beyond question, having been proven beyond a doubt; that any such knowledge will ever be revolutionized completely is as absurd as to claim that two and two are not four, and any one who makes such claims is nothing less than a self-exposed impostor. Those who are anxious to assist such claimants with their money should first find out whether he intends to revolutionize our real scientific knowledge or only our suppositions and beliefs; if the former, they will do better to give their money to the deserving poor. Many of the usual impostor's claims are more like those of a man who claims that the earth is flat or that it did not move, contrary to knowledge about which there is no longer the shadow of a doubt. If he were to claim that our suppositions about the constiution of the interior of the earth were wrong, he might deserve some respect.

FARADAY, MAXWELL AND HERTZ.

In another column we commence the publication of a paper by Prof. Pupin, of Columbia College, which will be found both of remarkable interest and unusual value, on the new conceptions introduced and developed in science by Faraday, Maxwell, Hertz and their school. Although glimpses of the philosophical ideas and methods there treated may be found in the writings of some of the sages of antiquity and had begun to take form several centuries ago, it it shown that their important consequences were first developed by the great mind of Faraday and by his no less wonderful experimental methods. The part of Maxwell in recognizing the full importance of Faraday's work, and the use he made of it, and, finally, the experimental demonstration by Hertz of the truth of what otherwise would have remained merely hypotheses, all of this forms a story of intense interest, and the admirable manner in which Prof. Pupin narrates it is in keeping with the loftiness of the subject, while his special competence to treat the ideas of this new school follows from the fact that he is one of its most competent representatives. The review of the subject brings out the transcendent value of the physical as opposed to the mathematical method of investigation; for, although Maxwell made use entirely of mathematics, yet he drew upon the stores of experimental data of Faraday as from nature, and his treatment was that of the physical mathematician, if we can use the expression, rather than of the mathematical physicist in its accepted sense. As the categories of Aristotle were accepted through long ages as the expression of all knowledge, and the labors of the learned were merely devoted to deducing new consequences, so the mathematical physicist is apt to merely accept facts in order to submit them to his mathematical processes, regardless of the immense physical meaning there may be behind them—his mathematical mechanism being of more importance than the physical mechanism with which the former is incompetent to deal at first hand. When dealing with continuous currents the theories of this school seemed to have only an indirect interest, but with the alternating current it is different, and with high frequencies they alone will give an insight of the phenomena involved. It will not be long before the electrician who wishes to maintain his standing will have to be as well acquainted with the modern developments of the Faraday-Maxwell theories as he had previously become with the older electrical ideas. As an introduction to these modern theories and as a broad discussion of their basis and significance the paper we print is therefore a most timely contribution, and one which none of our readers should fail to study.

Professors and Consulting Engineers.

In a discussion in the foreign journals regarding the advisability or inadvisability of the placing of the Niagara plant in the hands of a professor, one of the professors taking part in the discussion said that he thinks that a man who has gone through the mill must of necessity have become a practical engineer in the process. To this another correspondent replied that perhaps the professor had forgotten that there is more than one shoot in a mill, and that the products, such as flour and bran, for instances, differ widely in quality.

The Novak Lamp Case.

The arguments in the United States Circuit Court of Appeals for the second circuit in the Novak lamp case were heard in New York on Jan. 30, and it is thought that the decision of the court will be handed down about March 1.

The complainants in their arguments maintained that the single important question in the case is whether or not the defendants evade the Edison patent by making a lamp in all respects like those which have been uniformly held to infringe the Edison patent, except that, while exhausting the air from the enclosing chamber to an extreme degree, they introduce into the chamber a minute trace of bromine vapor. As to the presence of the bromine gas being an advantage or a disadvantage, the advantages or disadvantages are trivial and superimposed upon the entire Edison invention, which is present in its full extent. It was claimed that the courts had decided that it was an invention to originate the filament, and that what the courts meant by a high vacuum was one that would avoid the evils of both combustion and air washing, and that a vacuum of 1-30,000 of an atmosphere is now sufficient on account of the harder filament used than when Edison specified the higher vacuum. It was asserted that the use of bromine gas was not a novelty and no benefit to the lamp; that the use of inert gases was well known before Waring's alleged invention, as well as their prevention of blackening, and that the alleged saving in exhausting is a trivial matter.

In the oral argument the complainant's counsel stated that driving out occluded gases had nothing to do with the Edison patent, when he was interrupted by Judge Lacombe, who said very emphatically that it was a part of the Edison patent, and that, after the delivery of his opinion in the Edison case, when he had read a similar claim in the newspapers to that just made, he had called the counsel together and specially instructed them on this point.

The argument further claimed that while, as was known long ago, an inert gas does prevent blacking, it does not prolong the life of the lamp, but reduces it. The point of law was cited that the courts look with disfavor on attempts to evade a patent by those who deliberately adopt the substance of an invention and endeavor to conceal the infringement by a plausible but formal change, and that in the present case the defendants are successor to a company previously enjoined from infringing the Edison patent and have resorted to the use of bromine gas as an evasion. Also the points that he who uses the invention of another is an infringer, even though he may make a patentable improvement upon the original invention; that the degree of vacuum required by the Edison lamp must be determined by its function and purpose, and that the addition of a useless or inert element to a machine has never relieved the defendant of the charge of infringement. The complainants also claimed that the defendants had not made the full disclosure of details or a consistent explanation of seeming divergencies from the methods which they profess to employ. As to the point in reference to the expiration of the Edison American with the English Edison patent, it was submitted that the law is clear and fully settled in regard to the date of sealing and not the active date of the patent being the determining one. Regarding Judge Ricks' decision, it is claimed that the English patent neither in fact nor law had any effect upon the term of the Edison patent; that the action of the parties and the Commissioner of Patents in attaching the certificate of correction was void and of no effect; that there was no dedication to the public, because there was no intention to dedicate, and if there was it related only to a period after Nov. 10, 1893, before which period it was revoked; that no estoppel could arise, as the reference to the date of the English patent was a clear mistake, and equally within the knowledge of both of the parties; and that the whole transaction was simply an endeavor to bring the patent under section 4,887 of the Revised Statutes, and not a dedication. A final plea is made based upon the great expenses incurred by the complainants and their licensees and the short life left to the patent, which expires in November, 1894, or January, 1897.

The defendants, in their argument, claimed that according to the decisions of courts there was no patentable novelty in any of the separate elements of the Edison lamp. That an all-glass receiver, conductors passing through glass and a nearly perfect vacuum were not patentable; that the prior disclosure of a platinum filament in the French Edison patent rendered a filament unpatentable, and as carbon had previously been used, a carbon filament could not be patented nor a high resistance in a filament. The elementary rule was cited that inventors of a combination cannot suppress subsequent improvements substantially different, whether a new combination of the same ingredients or a substitution of a newly discovered ingredient, or of some old one performing some new function not previously known as a proper substitute. It was claimed that a nearly perfect vacuum is a necessary element of the Edison patent, and that such a vacuum cannot be produced by a mechanical air pump, such as used by defendants. The Edison "nearly perfect vacuum" means "an empty space" and the exclusion of all gaseous contents from the lamp chamber, including oxygen and nitrogen and other gases as well, and gases occluded in the filament and on the wall of the lamp chamber, and requires a degre eof rarefaction exceeding at least 1-3,000 of an atmosphere. None of these points are necessary in the Novak lamp, which uses a mechanical pump that cannot give a vacuum higher than 1-1,000 of an atmosphere, which does not expel the occluded gases, and which uses bromine gas in a degree of rarefaction exceeding at least 1-3,000 of an atmosphere is a substantially new invention, and not a mere addition to Edison's "nearly perfect vacuum," and that it brings substantial improvements in ease and cheapness of manufacture, efficiency, durability and freedom from blackening of the bulb. It was further claimed that the Edison lamp patent expired on Nov. 10, 1893. Complaint was made of the complainant's lack of good faith in attempting to have the court to understand that they were forced to procure Novak lamps by indirection. It was finally contended that complainants were guilty of laches in delaying to bring suit, and that the Waring company were wrongfully accused of being identical with the Perkins Electric Lamp Company.

Judge Acheson and Judge Hallett.

In the recent proceedings in the Federal court at Philadelphia, on an application by Edison attorneys for injunctions against several alleged infringing users of electric lamps, the question of Judge Hallett's decision at St. Louis was brought before the court in a request to exempt from the operation of the injunction certain lamps manufactured by the Columbia Lamp Company of the State of Missouri.

The judge, after referring to the Beacon lamp decision and that of Judge Seaman, says that as no evidence in support of the Goebel defense had been submitted to him, he was without means of forming an independent opinion as to whether it rests upon a substantial basis under all the circumstances, and therefore to give to Judge Hallett's refusal to grant an injunction the effect here claimed for it would be to carry the principle of judicial comity to a most extravagant length.

The Edison Electric Light Company, of Philadelphia, vitally interested here, the judge stated, is not a party to the Missouri suit, but aside from that consideration the owner

of a patent undoubtedly may maintain suits for infringement against the manufacturers and users of the patented device simultaneously. True, he added, pending a test suit against a manufacturer involving the validity of a patent in which a preliminary injunction against him has been decreed, courts in other jurisdictions have declined to enjoin preliminarily the users of the device. But the Edison patent has been sustained under circumstances which entitle the adjudication to high regard. It is the accepted doctrine that the decision of the Supreme Court, after exhaustive litigation upon the merits sustaining a patent, will ordinarily be regarded as conclusive on a motion for a preliminary injunction, the presumption against the existence of any valid defense against the patent prevailing at that stage of the case. As a consequence, the judge thought that the same effect ought here to be accorded to the decision of the United States Circuit Court of Appeals for the Second Circuit sustaining the Edison patent.

A preliminary injunction was allowed against each of the several defendants.

A Proposed Elevated Electric Railway.

An ordinance has been presented to the Philadelphia Council for an elevated electric road eight miles long, from Filbert and Eighth streets to Cheltenham. The conditions offered are that the piers will be of iron, the structure fourteen feet above all streets and twenty feet above any railroad crossing. The best methods of deadening sound are to be employed. Cars are to be run not more than ten minutes apart. The fare is not to exceed five cents for a continuous ride within the city limits between 6 and 9 A. M. and 5.30 and 7.30 P. M., and at all other hours is not to exceed ten cents. There shall be hourly cars from 1 A. M. to 5 A. M. The work is to be begun within six months and completed within three years. The company shall give $50,000 bonds for the faithful performance of all engagements and another bond of $50,000 to secure the payment of one-half of 1 per cent. of the gross receipts, which shall be sworn to quarterly by the officers of the company before the city controller. No freight cars shall be run on the road under penalty of $100 for each trip. Bonds of $200,000 will be entered to secure property owners for property "taken, injured or destroyed."

Award of the John Scott Legacy Premium and Medal.

The John Scott legacy premium and medal, which is awarded by the city of Philadelphia upon recommendation of the Franklin Institute, has been bestowed upon Mr. Nelson W. Perry for his method of series electric traction. The following is an abstract of the award:

Without entering into a discussion of the relative merits of the series and multiple arc systems of railway electric traction, it may be said that the very ingenious system presented by Mr. Perry seems to be well worked out in detail, and appears to overcome the difficulties arising in previously suggested series systems. Both the series and the usual multiple arc systems have their advantages and their disadvantages. While the former will not nor is it intended to replace entirely the multiple arc system at present in use, it has very decided and indisputable advantages in special cases, which cases are, however, by no means unusual. Its principal field of usefulness is in long lines, and the present introduction of railways leads to the belief that such railways will soon become very numerous.

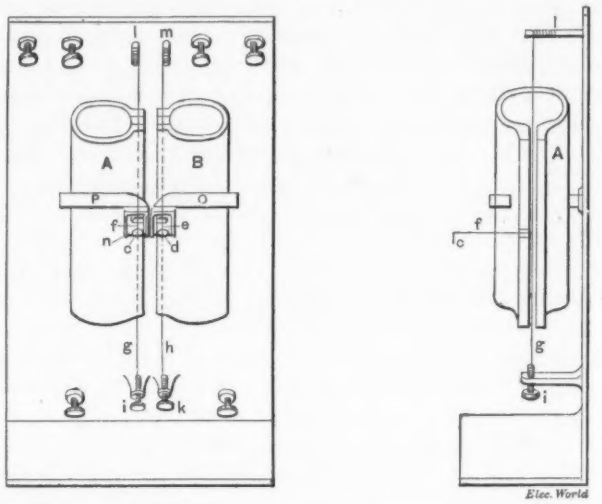
As far as can be determined of a thing that exists, so far as the knowledge of the committee extends, only on paper and subject to the risks which invariably attend reduction to practice, in the opinion of the committee a railway may be practically operated by the series system under Mr. Perry's plan, and with the safety due to a perfectly served and constantly signalled block system, for the current which drives the car not only sets the signal but refuses to work when two cars come on the same block. The Institute therefore recommends the award of the John Scott legacy premium and medal to Nelson W. Pery for his system of series electric traction.

An Instrument for Measuring Phase Difference.

BY W. STUART-SMITH.

I have for some time had in mind an instrument for showing directly in degrees the phase angle between a current and its impressed E. M. F. and at the same time showing the shape of the two waves. It has been my intention to have this made, but I have not found it convenient, and as it will be essentially a laboratory instrument, and hence of little commercial value, I give here a description of it.

As the sketches will show, the principle is the same as Ewing's magnetic curve tracer. In Fig. 1 *A* and *B* are two electromagnets energized by a steady current, the poles of which are so shaped that wires *g* and *h* can be stretched in



FIGS. 1 AND 2.—MEASURING PHASE DIFFERENCE.

the space midway between them. Fig. 2 shows one of these magnets; *c* and *d* are two very small mirrors, each supported by two horizontal needle points, *n*, so that in their normal positions the mirrors will rest in a vertical plane, as shown at *c*, Fig. 2. It will probably be best to pivot them near the bottom. Two short wires, *e* and *f*, are secured to the top of the mirrors and to the middle points of the stretched wires *g* and *h*. When the magnets are energized, but no current is flowing through wires *g* and *h*, the mirrors will be still and points of light reflected from them will simply show as points on a screen. If now an alternating current be sent through the wires, they will be attracted toward one pole or the other of the magnets, according to the direction of the current through them, and this movement being communicated to the mirrors through wires *e* and *f*, will cause them to rock slightly, and the spots of light on the screen will be drawn out into vertical lines, the length of which will depend upon the displacement of the wires, which in turn will depend upon the current passing through them. By properly adjusting the positions of the mirrors the two lines of light will coincide. If while the mirrors are thus vibrating the screen be given a rapid motion sideways, the two vertical lines of light will be drawn out as curves, the ordinates of which will depend upon the displacement of the mirrors at any instant and the abscissae upon the speed of the screen. The screen is, of course, supposed to carry a sensitive film and the exposure be developed to bring out the image. Such a high velocity can be given the screen by having it made as an endless band passing over the driving pulley of a small electric motor (set with its axis vertical) and over a guide pulley and stretched taut between them.

When no current is passing through the wires, if the mirrors are adjusted so that the two spots of light on the screen coincide and the screen then be put in motion, a

datum line will be drawn. If a third stationary mirror be employed and the three be adjusted so that all three spots coincide, then the spot from the stationary one will describe a datum line when the current is passing through the wires.

When all the mirrors are adjusted and the screen set in motion, if one of the wires, as *g*, be connected across the mains, the current passing through it will be in phase with the E. M. F., as the short, straight wire is without self-induction, hence the curve shown on the developed film will have ordinates proportional to the E. M. F., and will show the shape of the E. M. F. wave.

Wire *h* being connected in series with the main, its displacements will be proportional to the current, and the curve formed by the spot of light from mirror *d* will have ordinates proportional to the current, and hence will show the shape of the current wave. Both wires being connected at the same time, the two waves will be shown simultaneously and also the datum line from the stationary mirror. The two curves will be displaced, with respect to each other, an amount depending upon the phase difference.

By making several exposures at short intervals the variation of the shape of the two curves, together with the change in phase difference, can be recorded as the conditions of the circuit change.

Probably for very high rates of alternation the inertia of the moving parts will vitiate the shape of the curves, but by making them exceedingly light and having the wires stretched very tight, accurate curves can be shown for frequencies of comparatively high value. The mirrors will have motion in but one direction instead of two, as in Ewing's magnetic curve tracer, and this fact will tend to raise the frequencies, for which accurate results can be obtained. Probably frequencies found in modern power transmission plants would not be beyond the limit of accuracy, even if the connections were allowed to remain for some time, so as to permit several curves to be made while the conditions were changing. Frequencies of a much higher rate could be accurately registered by having the motor make connections and take an exposure at, say, the first or second vibration of the mirror.

Ewing says (see The Electrical World, Oct. 8, 1892) that with his curve tracer 20 cycles per second are not beyond the limit of accuracy, even when the mirror has a double motion and the wires sufficiently slack to give a diagram of good size, and that for very high frequencies the mirror should have but one motion. His instrument traces a curve depending upon two variables, hence a mirror having a double motion is necessary, but with the instrument here proposed, one of the elements, time, is a constant, hence this component of the curve can be supplied by the moving screen.

For parts of the curve above the datum line the mirror *c* will be vibrated by a pull on the wire *f*, Fig. 2, and for the part below by a push; this can probably be accomplished, as wire *f* can be very short, and the force it exerts need be but slight. If this is not found practicable, it will not be difficult to give the necessary motion.

If at the time the mirrors were being vibrated, as above, further motion should be given them, so as to displace the spots of light in a horizontal direction also, luminous curves would be shown on the screens, and if the third mirror was also similarly vibrated, the datum line would also be shown. This being the case, if a straight scale be graduated in degrees and an illuminated image thrown on the screen through a lens, then by adjusting the lens the 0° and 360° marks can be made to coincide with the points where the E. M. F. curve cuts the datum line, and if the graduations extend beyond these marks the phase difference between the two curves can be read directly in degrees.

This double motion would complicate the apparatus so much that inertia would be a more serious defect, and the connection between the stretched wires and the mirrors could not be as simply made. The limit of accuracy would be found at much lower frequencies than when the mirrors had but one motion and a photographic image was made.

If the screen be painted with sulphide of calcium and the light from the mirrors allowed to fall upon it, light will be absorbed and a luminous image of both curves, the datum line and the scale will be shown when the mirrors have but one motion, and this luminous image will not vanish at once, but will last probably for several minutes, so that it can be examined and even fixed by marking with a pencil. Such a surface would not require constant renewal, as the sulphide of calcium when of good quality will retain its property of absorption of light with after illumination for three or four years. With the short exposure to which it would be subjected in this case, probably the image would disappear after a few minutes, but if submitted to diffused daylight for say ten seconds it will shine for ten hours or more.

Unless it was desired to obtain a permanent curve on photographic film, this luminous surface would be of great advantage. It could also be used with Ewing's curve tracer where a permanent record was not desired, but a few minutes required for examination, as when testing iron in a workshop where a specimen was to be compared with a standard.

This is essentially a laboratory instrument, but I have designed one on totally different principles, which will give the angle of phase difference in degrees directly but not show the shape of the curves. This instrument is extremely simple, has no parts requiring special adjustment, and is as easy to connect up and read as a Weston voltmeter. It is essentially a central station instrument, and requires no adjustment other than approximate leveling. Placed in a central station beside the voltmeter and ammeter, the phase difference would be read (after closing a switch for a moment) and recorded in the hourly records and add greatly to them, as it would enable the power at any time to be quickly determined. It can be used for either high or low frequencies.

Progressive Evolution of the Telephone System of To-Day.

Mr. T. D. Lockwood recently delivered a lecture before the Electric Club of Harvard University on the "Progressive Evolution of the Telephone System of To-day." After a few happy introductory remarks, Mr. Lockwood proceeded to trace the invention of the telephone and its development into the modern perfected instrument. He said it was essential that the nature of sound should be clearly understood; that the physiology of the organs of speech and hearing be well known before the invention of a practical telephone was a possibility, and, in addition to this, a man thoroughly equipped for the invention was necessary. Such a man was Alexander Graham Bell, whose preparation for this work Mr. Lockwood commented upon. He described briefly the magneto telephone and its principles of operation. He then took up the subject of transmitters, and considered also the various elements of the telephone outfit. The question of disturbances on the line was next taken up, and it was shown how these may be obviated or decreased. The central station and its method of operation was considered by the speaker and briefly and clearly treated. A brief outline of what has been accomplished in commercial long-distance telephony, with interesting information in regard to the New York-Chicago line, was next given, and the lecture was concluded by some remarks in reference to possible future telephone work.

A Brief Review of the Faraday-Maxwell-Hertzian Epoch.

BY M. I. PUPIN.

THE death of the late lamented Prof. Heinrich Hertz brings to a close the most important epoch in the history of the electrical science of our times. The future historian of this most fascinating of all sciences will certainly record the names of Faraday, Maxwell and Hertz as the representative names of this wonderful epoch.

The essential features of the researches of these most eminent investigators are too well known to need a review, even from a pen guided by more experienced judgment and deeper penetration than I could even pretend to possess. But these are the days of mourning for the loss of rare Heinrich Hertz, and the thoughts of sorrow cause us to pause and reflect even more than ever before upon the wonderful discoveries of the departed young physicist. Yet who, while passing in his imagination through the wonderland which these discoveries disclosed before our view, does not feel that he is called upon to contribute a word or two to the memory of the man who opened our eyes and helped us to see as clear as daylight those visions which were first discerned by the penetrating eye of Faraday and which soon after agitated the poetic soul of Maxwell!

What are these visions, and why had we to wait in anxious suspense for nearly a quarter of a century until the magic touch of Hertz opened our eyes and made these visions as clear to us as they must have been to Maxwell, probably as long as forty years ago, when he first drew his inspiration from the study of Faraday's "Experimental Researches in Electricity"? When I speak of the visions of Faraday and of Maxwell, it is far from me to suggest, even, that there is a single sentence in the writings of these prophets of science which could at any time have appeared to any well trained scientific mind as pure speculation. I simply refer to the radical difference of their views of electrical phenomena from the generally accepted views of their time, so radical, indeed, that nothing short of new and startling experimental discoveries could tear us completely away from the old scientific faith in which we were brought up and lead us to the new, the faith of Faraday and Maxwell. In Hertz we found this leader, and we followed him, because it was through him that we first saw the whole truthful simplicity of the new scientific faith.

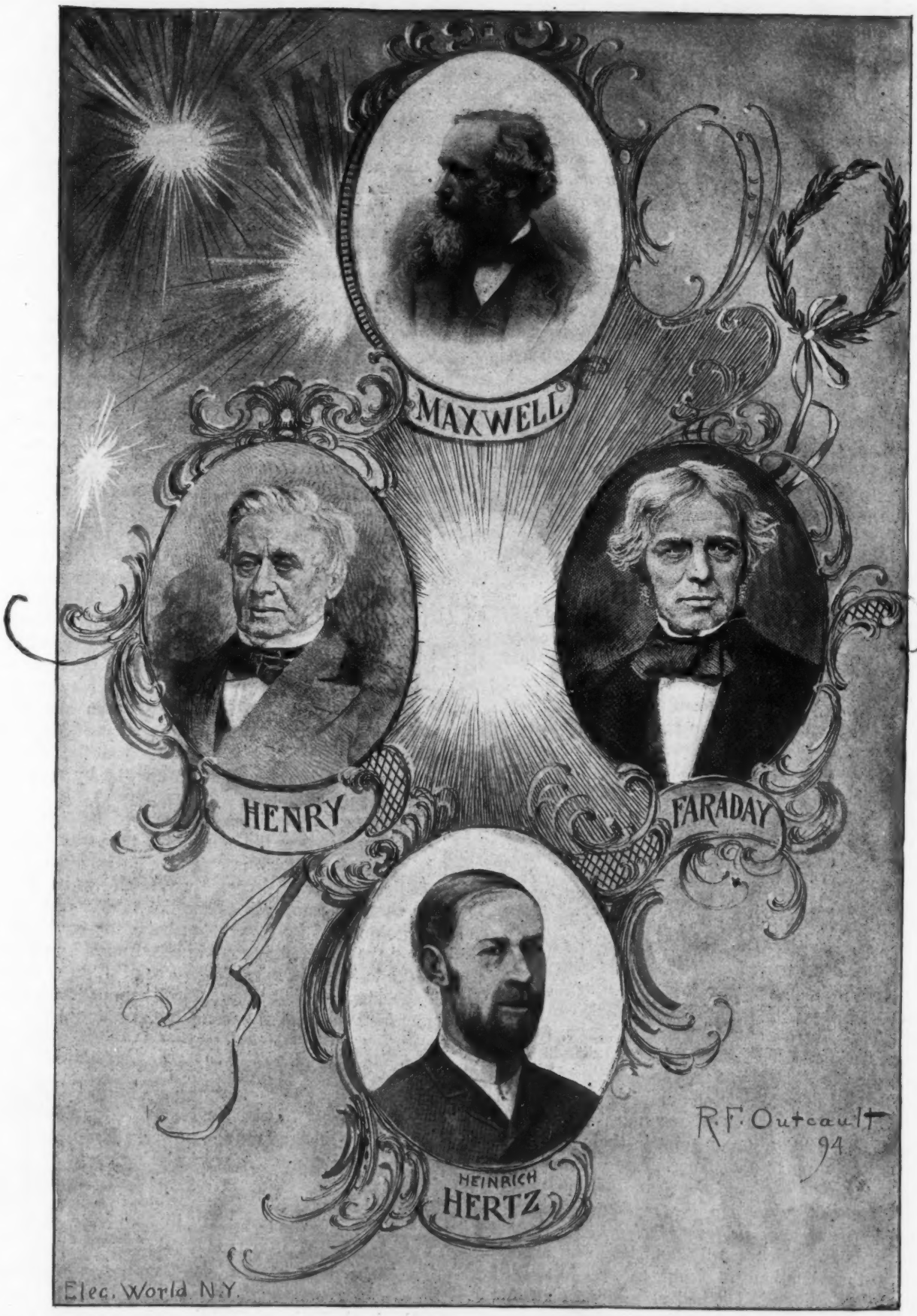
Every new physical truth appears to us first as a vision. It is brought then into harmony with our existing knowledge and finally becomes an essential part of our mode of thinking. We call it then simply a physical fact. Sir Humphrey Davy's and Rumford's experiments transformed the visions of Boyle, Leibnitz and Bernoulli concerning heat into a physical fact; the fact, namely, that heat is a form of energy. *So the experiments of Hertz transformed the visions of Faraday and of Maxwell into a physical fact; the fact, namely, that electrical phenomena, both static and dynamic, are ultimately due to a peculiar state or activity of the same medium to whose undulations we owe our sensations of light, and that light itself is an electromagnetic phenomenon.* The process of transformation of the visions concerning heat lasted over a hundred years. In the case of electricity it was more rapid; only fifty years elapsed between the first dawn of the visions of Faraday and the experimental discoveries of Hertz. Over two thousand barren years dragged their slow length along between the crude dynamical visions of Aristotle and the publication of Newton's Principia.

But during the period which intervened between the time of Aristotle and that of Newton the human mind was in matters of exact scientific thought just like an untutored child. It had to be trained in the correct conception of the ideas of numbers, space, time, motion and matter before the seeds of the idea of force could find there a congenial soil. Arithmetic, algebra, geometry, astronomy and alchemistry had to precede the science of dynamics. So, again, the somewhat faint outline of the idea of work and energy as it existed in the minds of Boyle, Leibnitz and Bernoulli had to develop gradually into a strongly defined mental concept, such as we find it, for instance, in the writings of Young and Faraday, before the human mind was ready to pass from the visions of these prophets of science to a definite formulation of the dynamical view of heat and the general principle of conservation of energy. I purposely mention the name of Faraday in this connection, because it is important to observe that the ideas of force and energy were just as clearly defined in Faraday's mind as they are in our own minds today. That remarkable argument in volume II., page 103, of his researches, by which he strives to refute the contact theory of electricity, on the ground of its violating the principle of conservation of energy, shows clearly that as far back as 1840 he felt the whole force of this great principle. Faraday was, therefore, just as well equipped as any scientist of his time to make the next step in the advancement of the then existing ideas of force and energy. There was, indeed, great need not only for an advance, but for a complete reform; the time was ripe for it, and Faraday was the very man to take the leadership in this reform. He was not trained in the school of the great mathematical physicists of the eighteenth century. His mind rebelled against the more or less settled view of that time, that the ultimate analysis of the phenomena of electricity and magnetism can do no more for the electrical science than Newton did for celestial mechanics, and that is to reduce all the phenomena to the action of forces between the elements of electrified or magnetic bodies, which action is completely determined by the distance between these bodies. It is this rebellion, first started by Faraday, which constitutes the Faraday-Maxwell-Hertzian epoch in the history of electrical science. Maxwell gave it a complete organization and Hertz gained the decisive victory. But it must be observed that without the noble service which men like Henry, Thomson, Helmholtz, Rowland and others had rendered to the cause of this rebellion, Hertz's victory might have come much later.

It is important now to describe briefly the hostile elements which opposed the reforms at which this rebellion aimed.

The mathematical physicists of the eighteenth century had achieved great things by the application of Newton's law of gravitation and Newton's dynamical principles to the determination of the figure of the earth, to the theory of tides and to celestial mechanics; so great, indeed, that the conviction grew strong that a knowledge of the law of action of forces acting between bodies, that is, the mathematical relation of these forces and the distances of the bodies between which they act, was the only key by means of which an access could be gained to Nature's secret workshops. Coulomb's law of action of magnetic poles and electrified bodies formed the basis of Poisson's and Green's most profound mathematical investigations in electricity. No sooner had Oersted discovered the magnetic action of electrical currents than Ampere proceeded to reduce that action to forces acting between the elements of conductors, according to laws which depended upon the position of these elements, and he enriched the science of physics by another set of forces varying inversely as the square of the distance.

What could be more simple than the reduction of a whole class of physical phenomena to a few simple laws whose language is so plain that a child could understand it! For certainly nothing is plainer than the idea of a distance. The



FOUR MASTERS OF ELECTRICAL SCIENCE.

same elegance in form and completeness in logic is found in these electrical investigations as in the Mecanique Celeste of Laplace. It was evident that all this fascinating beauty of form and polished simplicity in logic was owing to the simplicity of the fundamental laws, the laws of inverse square, from which these investigations started. Hence, one cannot help thinking that these great mathematical works helped to foster the belief that, just as in the case of gravitating masses, so in the case of electric or magnetic bodies, the distance between them was the essential element to consider in investigating their mutual actions. *The belief in direct action at a distance which had somehow or other crept into dynamics of gravitating bodies was transplanted bodily into electrostatics, magnetism and electrodynamics, and thrived there splendidly.* To question this belief would have appeared at that time like questioning the perfection of the classical works of Poisson and Ampere, and even of Laplace. William Thomson, now Lord Kelvin, discussing in 1842 some of Faraday's researches in dielectrics, states very carefully (as if by way of an apology) that the new view of electrical action, the view of Faraday, does not in any way conflict with Coulomb's law of inverse square. This law seems to have been identified by many with direct action at a distance hypothesis; more than that, this very identification seems to have infused this belief with a wonderful vigor; otherwise it should have tumbled down into dust at the very first onslaught of Faraday's almost irresistible argument. But, as it was, it seemed even to grow stronger, owing to the splendid achievements of the electro-mathematical researches of Franz Neumann, Gauss, Weber and other contemporaries of Faraday.

Not that these investigators were pronounced champions of the action at a distance hypothesis, but simply because their mathematical theory gave what was considered at that time a complete account of the experimental observations, although the fundamental relations from which they started took no account of the mechanism by means of which one electrical or magnetic body acted upon another. Their silence on this point was interpreted, if not as a direct consent to the direct action at a distance hypothesis, then certainly as a consent to the generally prevailing opinion that this hypothesis is the simplest of all, and that it leads to no contradictions with actual observations.

Objections against this hypothesis had been raised many and many a time long before Faraday's time. Newton himself was decidedly against it. Ampere went even so far as to suggest that electrical and magnetic actions are conveyed by the ether, the same substance which, according to the magnificently worked out theory of his young friend, Fresnel, conveyed the luminous energy from point to point in space, not to mention the speculations of Descartes and Boscovich, both of which were pointed directly against the direct action at a distance theory. But all these objections and suggestions had little or no weight. They were all based on a more or less metaphysical foundation. The only real point in their favor was the fact that direct action at a distance passes beyond our understanding. *On the other hand, however, they all seemed to introduce additional difficulties into the mathematical analysis of electrical phenomena without offering any reward for this additional labor.* Necessarily so, because experimental science at that time had no wealth to offer in reward for this additional exertion, and it had no simple, plausible theory to substitute in place of the "direct action at a distance hypothesis." It was Faraday who added this wealth and made some vague promises of the reward; it was Maxwell who first discovered the hidden treasures of this wealth, and in most glowing colors described the reward that we would gain by abandoning our old scientific faith in the "direct action at a distance hypothesis" and embracing the new faith of Faraday, and it was Hertz who first convinced us all that Faraday's and Maxwell's promises, though apparently too good to be true, were even more than true. A brief review of this wealth, of Maxwell's discovery and description of its hidden treasures, of the rewards promised by Maxwell, and of Hertz's first installment of these rewards is now in place.

(To be continued.)

Air-Core Transformers.

BY FREDERICK BEDELL AND ALBERT C. CREHORE.

In a paper on "The Behavior of an Air-Core Transformer when the Frequency Is Below a Certain Critical Value," read before the Physical Society, Oct. 27, 1893, Mr. E. C. Rimington has called attention to the case in which the primary current of a transformer falls off when the secondary is closed. This phenomenon was noted by us last spring and attention called to it in The Electrical World, June 17, 1893, in Article V., on the "Theory of the Transformer," where a curve is drawn (Fig. 14) showing the value of the primary current for different loads. We have not yet seen the full text of Mr. Rimington's paper, but from various references to it would infer that much of the same ground has been covered by him as was given by us in a paper before the Electrical Congress in Chicago last August entitled "General Discussion of the Current Flow in Two Mutually Related Circuits Containing Capacity," printed in full in the "Physical Review" for September-October, 1893. In a more recent communication Mr. Rimington calls attention to the fact that Mr. Kennelly, in an article entitled "The Impedance of Mutually Related Circuits" in The Electrical World for Oct. 21, covered some of the same ground as that given by him in his paper before the Physical Society above referred to. In a geometrical treatment of the same subject, "Theory of the Transformer.—VIII.," The Electrical World, Nov. 25, we showed the identity between analytical and graphic methods of solution, including that of Mr. Kennelly, and showed that the whole is derivable from the results given in the paper above referred to, presented by us before the Electrical Congress.

This decrease in the primary current of the transformer as a load increases, where the constants of the transformer have certain particular values, is certainly an interesting one, although the amount of decrease would always be small. Although the transformer has been the subject of a great deal of discussion, and its theory has been approached from all sides, and the instrument experimented upon by many different methods, it is still a fruitful source of study to the theorist and experimenter, and there is still room for the discovery of many facts interesting and unique.

Utilizing Tidal Power.

Another scheme has been advanced for utilizing the rise and fall of the tides as motive power. Experiments are reported by the London "Electrical Engineer" to have been made with the invention on the coast of Cheshire, where a tidal mill of about 4 h. p. has been used to supply power for driving a dynamo for lighting a house by electricity.

A Difference Between This Country and England.

In England all electric lighting plants and all methods of traction are in charge of "undertakers"; in this country the only plants with which undertakers are concerned are those which are planted in cemeteries on the graves of deceased relatives, and the only case of traction in which undertakers are interested is the old style horse traction applied to hearses and funeral carriages.

Some Unique and Useful Methods of Measurement.

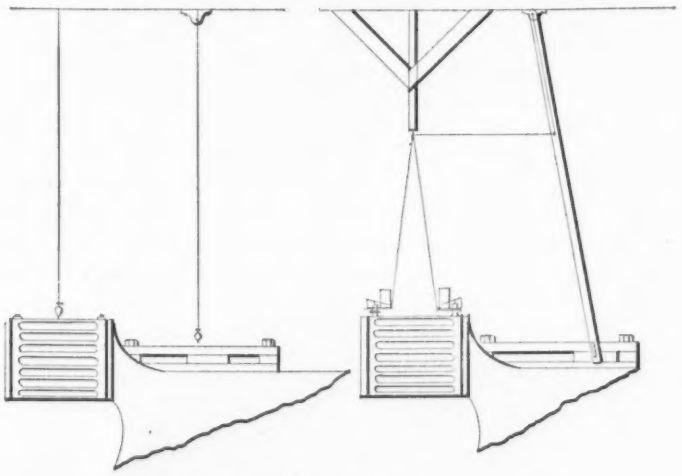
BY GEO. T. HANCHETT.

IT very often happens that an electrical engineer finds the apparatus at hand inadequate to determine the value of a quantity which is of prime importance in calculating results. It is to such cases that this article is devoted, and while not all of these are covered, the writer hopes that the methods herein mentioned will suggest others.

In the case of an isolated plant, where the engineer appears upon the scene with a voltmeter and an ammeter in one hand, a pair of indicators in the other and having but one day in which to make the test, it too often happens that some such knowledge as the following is absolutely necessary:

With regard to the engine first: The writer is very sorry to say that in many cases the engineer in charge has never even heard of an indicator card, and the box of indicators is as much an object of open-mouthed wonder to him as an amateur photographer's outfit is to small children on a farm. Consequently there is no reducing rig on the premises. A reducing can be made cheaply, and, what is of more importance, quickly, from the following materials: A piece of scantling ten feet to twenty feet long, according to circumstances, and of about 2 inch by 3-4 inch cross-section; an 8-foot or 10-foot piece of about 2-inch by 4-inch plank; two small pulleys and a sufficient quantity of braided curtain cord, or something equally strong and non-elastic.

From these materials a reducing rig can be prepared thus:



FIGS. 1 AND 2.

Drop a plumb line from the ceiling to the middle point of the ways of the cross head and at this point in the ceiling a pivot must be provided for the long piece of scantling; as shown in Fig. 1. One end of the piece of scantling should be furnished with a bearing to receive this pivot on the ceiling. In the other end should be cut a slot to receive a screw or pin on the cross head. In almost all high-speed engines accommodations for this pin or screw are provided. From the ceiling drop a plumb line to the middle of the cylinder, and at this point in the ceiling firmly fix the eight-foot plank in a vertical position, with its width parallel to the head of the cylinder.

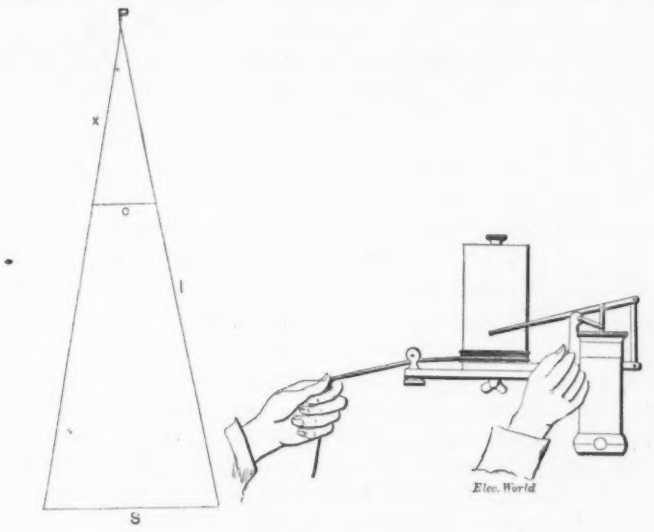
Having decided upon a length of card, measure the long piece of scantling and the stroke of the engine. Then, by the following formula compute the distance of a point on the rod to the pivot in the ceiling:

$$x = c\,\frac{l}{s}$$

when x is the desired distance; c the length of the card; l the effective length of scantling in the position shown in Fig. 2; and s the length of stroke. (See Fig. 3.)

On the eight-foot plank, at a distance approximately x from the ceiling, attach the two screw pulleys in such a way as suitably to lead cords to the indicators at either end of the cylinder. Connect the cords to the indicators, as shown in Fig. 2, and a reducing motion is obtained whose errors are so small as to be masked by the greater errors of the indicators themselves.

The speed of the engine is a troublesome thing to determine, particularly if a man has forgotten his speed counter. In the case of any engine which has a speed lower than 200 revolutions the speed can be counted directly by allowing some one of the moving parts to touch one hand at every revolution, keeping the eye fixed on a watch held in the other. Another way is to turn one of the indicator cocks so



FIGS. 3 AND 4.

that intermittent puffs of steam are ejected through the hole in the side and count by ear instead of by touch. With a little practice the error should not exceed one revolution, even when the speed is as high as 150.

The speed can also be found, approximately, as follows: Let a quarter-minute interval be used, and a few seconds before the even quarter with one hand draw out one of the indicator cords slowly and as nearly uniformly as possible, and thus rotate the drum. On the even quarter apply the moving pencil motion to the drum, releasing it at the end of a quarter of a minute. The speed of the engine can now be obtained by counting the number of crests on the card thus formed and multiplying by four. (See Figs. 4 and 5.)

The writer does not wish to give the impression that these methods are to be desired in any carefully arranged test; they are fairly accurate substitutes when no other methods

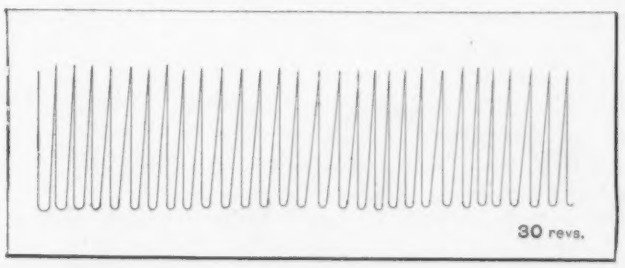


FIG. 5.

are at hand. For the sake of information, let us examine their accuracy. First, with regard to the reducing rig: Suppose the stroke of the engine to be 12 inches, the length of the oscillating scantling 10 feet, 120 inches, and the desired card length 3 inches. A little consideration will show

that none of these values is improbable. Applying the formula

$$x = c\,\frac{l}{s},\ \text{we have}\ x = 3\,\frac{120}{12} = 30\ \text{inches.}$$

In order to be absolutely correct the cord should wind upon a specially shaped segment, which is very nearly the arc of a circle struck with x as radius and p as centre. An arc 3 inches long struck with a radius of 30 inches would be only 1-63 of the circumference. Consequently, a straight line such as is given by this device is very little shorter than the arc which it subtends. If it is wished to be more exact the length of the arc may be computed from its radius, and the difference between it and the subtending chord added to the length of the card; or, the arc may be described with a string and pencil and its length determined.

There is also a certain advantage over the circular segment in the crank and connecting rod motion of the cord, but it would be tedious to discuss it here. Suffice it to say that the writer is not alone in his opinion of the accuracy of this device, but could name several eminent steam engineers, some of whom are professors in our foremost polytechnic institutes, who have thoroughly indorsed it. One of these declares it good enough for a Hirn's analysis, were it not for the fact that some steam engineers, who have not investigated its errors and know nothing of its final effect on the card, would condemn it at once. It is to avoid such condemnation, and for this reason only, that he wishes his reducing rigs to be above criticism.

With regard to the method of indicating the speed: In the case of slow-speed engines the writer prefers direct counting to the hand-speed indicator as the more accurate method. With high-speed engines the accuracy depends upon the practice of the engineer in such counting. Indicating the speed by the indicator is also a matter of practice. Of course all errors made on the card are multiplied by four. With a slow speed a half-minute interval may be used, and it then becomes so easy to obtain the speed exactly that an error of one revolution should be inadmissable. A series of ten or more indications and their mean should then render this part of the data above reproach.

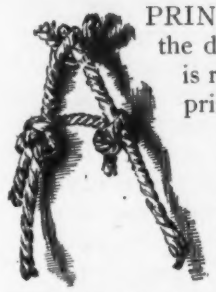
"Waterpail Forge."

Mr. George D. Burton, of Boston, before the Franklin Institute of Philadelphia, last Wednesday, showed the method of heating by plunging the metal to be heated into a bucket of water and passing a strong current through it. The apparatus consisted simply of an ordinary wooden bucket containing a large sheet of lead which formed the positive pole and an iron bar laid across the bucket forming the negative pole; the metal to be heated was held in the tongs, which were rested on this iron crosspiece and dipped into the liquid as desired, thus avoiding all flexible connections with the tongs. Two ordinary nails held in the tongs and dipped into the liquid were heated to a welding heat in a few seconds, after which they were welded on an anvil with a few blows of the hammer. In another experiment they were welded by simply allowing them to fuse together. A large soldering iron was heated red hot in less than a minute. Pieces of clean steel were heated to redness to show that they were not burnt, as in the ordinary forge.

The solution which he found to be the best, after a long series of experiments, is made of a solution of ten parts of carbonate of soda and one of borax, dissolved in water until the specific gravity at 70 degrees is 1.150. The current was taken from the street mains and at about 240 volts. It appears that no means of regulating the current were used, as the metal itself and the depth of immersion acted as the regulator. He claims to have made the first public exhibition as early as October of 1890.

Rope Driving.—VIII.

BY J. J. FLATHER.



PRINT obtained with a plaster cast, showing the distortion of the strands from a true circle, is reproduced in Fig. 27. Fig. 28 is a similar print, showing the relation between the actual area of the cross-section and the area included between circular strands and the tangents joining them. It will be noted that the excess of area outside of the lines drawn tangent to the inner circles is but slightly greater than that between the tangents and the inner circles.

An inspection and tabulation of the results of numerous tests on manilla rope* shows that the strength per square inch increases as the diameter of the rope decreases. Formulas for the strength of rope based upon the circumference and a constant multiplier—as, for instance, $S = 800\,c^3$, where S is the breaking strength and c the circumference—must be regarded as giving only an average value for diameters approximating those experimented upon. As the strength of good manilla rope varies from 10,000 pounds per square inch for a 2-inch rope to over 12,000 pounds for a half-inch rope, it can be seen that a more accurate determination may be made if a variable is used in the formula. With the above assumption of area ratios, obtained by trial, the following expression has been deduced, which will give a very fair value of the breaking strength for new manilla ropes: $S_1 = 100\,d^2\,x$, in which x is a variable depending upon the diameter of rope; for manilla rope we may assume the em-

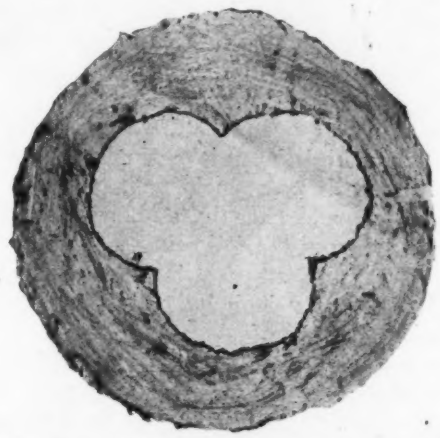


FIG. 27.—ACTUAL SECTION OF ROPE.

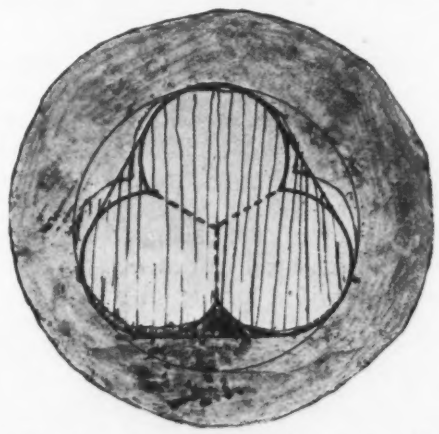


FIG. 28.—CROSS SECTION OF ROPE.

*Major Parker's report of tests made at Watertown Arsenal, 1885. Ex. Doc., No. 36. Experiments of M. Doboul in "Bulletin de la Societe d'Encouragement des Arts," Paris, 1888. Riehle Bros.' laboratory tests; and others.

pirical value $x = 81 - 9d$, where d is the diameter in inches.

The ultimate strength per square inch of actual section will then be:

$$S = \frac{S_1}{0.8\ \frac{\pi}{4} d^2}.$$

From these formulas Table I. has been computed:

TABLE I.—STRENGTH OF MANILLA TRANSMISSION ROPES.

Dia. of rope = d.	Breaking strength, $S = 100\, d^2 x$.	Strength per square inch, $S = \frac{S_1}{0.8\ \frac{\pi}{4} d^2}$
½	1,900	12,200
⅝	2,900	11,950
¾	4,100	11,750
⅞	5,500	11,525
1	7,100	11,350
1⅛	8,800	11,125
1¼	10,900	10,975
1½	15,000	10,625
1¾	19,800	10,300
2	25,100	10,000

The above values are for new manilla ropes made of selected stock; ropes that are greasy or wet will be reduced in strength from 20 to 30 per cent., but when ropes are used for transmission of power, the lubrication of the fibres is of more importance than the actual breaking strength of the rope, as in any case the apparent working strain, as calculated from the power transmitted and the speed of the rope, should not be taken greater than 5 per cent. of the ultimate strength; in many cases not more than 2 per cent. is used. If we wished to obtain the working strength we would usually divide the breaking strength by an assumed apparent factor of safety, but for a flying rope, in addition to this, it is necessary to provide a factor of wear; moreover, the actual strains are generally much greater than the normal as calculated from the power transmitted, due to vibrations in running, imperfect tension mechanisms, defects in construction, and other causes. As the strength at the splice is only 70 to 75 per cent. of the strength of the rope, the actual margin for wear and unknown strains is not as large as would at first seem apparent. In the first place, the strength of a lubricated rope is weakened about 25 per cent. by the grease, then 25 per cent. more must be deducted for the strength at the splice; this leaves only about 50 per cent. of the original strength of the rope which is available for transmission of power; to allow for possible imperfections in the rope, due to its manufacture or the material used, we must allow a further reduction of say one-fifth (that is 10 per cent. of the original strength of an unlubricated, unspliced rope); thus we have only 40 per cent. of the original breaking strength, which we may consider as the actual working strength. Allowing 10 per cent. of this as the apparent working strain (equals 4 per cent. of original strength), we obtain 36 per cent. as the actual margin for wear and unknown stresses which may be set up in the rope.

The working strain in executed rope transmissions will be found to vary considerably, as shown in the table herewith;

TABLE II.—EXECUTED ROPE TRANSMISSIONS.

H. P. of engine.	Diameter of rope.	No. of ropes or wraps.	Velocity of ropes. Ft. p. m $= V$.	Driving force $= P$.	Probable ratio max. tension to driving force $\frac{T}{P} = \frac{T_1}{P}$.*	Corresponding value of maximum tension $= T_1$. $T_2 = 200\, d^2$.	Assumed allowable strain from	Material of rope.	Remarks
2,000	1¾	30	5,089	367	1.66	608	612	Cotton.	English.
1,350	1¾	27	5,186	318	2.3	730	612	Manilla.	Waterwheel.
1,300	1¾	32	5,338	251	2.35	590	612		English.
1,200	1⅝	36	4,398	250	2.12	530	528		English.
1,200	1¾	27	5,277	278	2.35	680	612	Manilla.	In use 3 years; good condition.
1,200	1¾	20	5,100	390	2.0	780	612	Manilla.	
1,100	1⅝	35	4,490	230	2.12	485	528	Cotton.	English.
1,100	1¾	26	4,900	275	2.25	620	612	Manilla.	
1,062	1¾	27	5,086	255	2.25	575	612		English.
1,000	1¾	23	5,227	282	2.35	660	612	Manilla.	
800	3½	24	1,230	890	...	1,520	2,450	Cotton.	Used 3 yrs. without resplicing of ropes.
750	2.36	30	3,000	275	1.86	510	1,114	Hemp.	German.
450	1¼	14	4,850	220	1.66	365	312	Cotton.	In use 6 years; good condition.
350	1¾	12	5,166	186	1.66	308	612	Cotton.	English.
300	1¼	16	3,342	186	1.9	355	312	Manilla.	In use 2 years; no signs of wear.
250	2	12	1,470	470	1.32	620	800	Cotton.	
200	1¼	6	3,926	280	2.0	560	390**	Rawhide.	Wore out in 4 years.
200	1	12	3,078	178	1.86	330	200	Manilla.	
200	1	10	2,400	275	1.8	495	250**	Rawhide.	In use 3 years; good condition yet.
150	1	13	2,400	158	1.8	285	250**	Rawhide.	
150	1¼	6	2,800	295	1.83	540	312	Manilla.	
150	⅞	18	3,190	82	1.86	152	190**	Rawhide.	In use 3½ years; very little wear.
140	¾	8	2,480	230	1.8	415	112	Manilla.	Three ropes worn out in 2 years.
100	⅞	5	4,333	152	2.1	320	190**	Rawhide	Worn out in 3 years.
80	1⅛	7	2,513	150	1.8	270	252	Manilla.	In use 3 years; good condition.
60	¾	2	3,600	275	1.9	540	112	Manilla.	Would last from 4 to 6 months.
60	2	5	1,592	246	1.7	415	800	Hemp.	German.
50	1⅛	1	1,800	920	1.72	1,600	252	Manilla.	Broke 3 times 5 mos.; replaced in 5 mos.
50	⅝	4	2,513	164	1.8	295	78	Manilla.	Would last 6w. to 4m.; finally taken out.
45	1¼	5	1,700	175	1.72	300	312	Manilla.	
40	2	1	5,000	265	1.66	490	800	Cotton.	In use 8 years; good condition yet.
35	⅞	9	1,318	97	1.7	164	153	Manilla.	In use 3½ years; no signs of wear.
30	⅝	3	2,256	146	1.77	257	78	Manilla.	
25	¾	1	3,140	262	1.86	490	112	Manilla.	Wears out in 1 year.
20	½	4	3,140	55	1.86	120	50	Manilla.	Quarter turn drive.

* Calculated from $\frac{T_1}{T_2} = \varepsilon^{\Phi \alpha (1 - z)}$; Φ is assumed equal to 0.5 for cotton, and 0.3 for manilla and rawhide. The arc of contact on smaller pulley was taken as 165 degrees in all cases.

** The assumed allowable strain for rawhide ropes was taken at $250\, d^2$ pounds. No distinction was made between manilla and cotton.

In determining the driving force, $P\ \left(= \frac{33{,}000 \times \text{H. P.}}{V}\right)$, no allowance was made for engine resistance, which will reduce the above values about 10 per cent. for the larger engines, but this refinement is unnecessary in view of the fact that engines are frequently run at a higher power than their normal rating.

but plants which have been successful, as well as those in which the wear of the rope was destructive, indicate that 200 d^2 pounds is an economical working strain.*

As this value is such a small percentage of the breaking strength, it is unnecessary to use a varying coefficient in this case, as the difference is not worth considering. From data furnished by the Messrs. Pearce Brothers, of Dundee, who have erected rope belting extensively, Prof. Unwin shows that in different cases in practice the driving force, or difference in tension, on the two portions of the rope is equal to 75 to 80 d^2 pounds; that is,

$$T_1 - T_2 = P = 75 \text{ to } 80\ d^2,$$

where T_1 = tension on driving side,
T_2 = tension on slack side,
P = driving force.

It is probable that the value of the ratio $\frac{T_1}{P}$ varies from $1^1/_2$ to $2^1/_2$ in ordinary practice, depending upon the speed of the rope, the coefficient of friction and the arc of contact between rope and pulley.

Unwin assumes $\frac{T_1}{P} = 1.2$ when the belt embraces 0.4 of the circumference of the smaller pulley; hence the greatest tension would be

$$T_1 = 1.2\ P = 90\ d^2 \text{ to } 96\ d^2.$$

This is based upon a coefficient of friction = 0.7 for a 45° groove, which we believe to be greatly in excess of its average value for running ropes. Moreover, the rope velocity was not considered in determining the above ratio; at speeds over 2,000 feet per minute the influence of centrifugal force cannot be neglected, as it produces a very considerable force in the rope, and for these reasons the value of the ratio $\frac{T_1}{P}$ will be greater in average practice than 1.2.

If we assume a speed of 4,000 feet per minute, the value of this ratio for greasy ropes may be taken equal to 2, from which there is obtained $T_1 = 2.0 \times 75$ to 80 $d^2 = 150$ to 160 d^2—a value somewhat less than that which we have assumed as a suitable working strain, viz., 200 d^2 pounds. In a recent communication from Messrs. Combe, Barbour & Combe, of Belfast, who have been engaged in furnishing rope transmission for thirty years, it is stated that their basis of calculating the horse power is to assume that a rope 5 1-2 inches circumference (1 3-4 inches diameter) working on a four-foot pulley going 100 revolutions per minute will drive 8 h. p. under medium circumstances, and by "medium circumstances" they mean "that the ropes must work at a distance of at least 20 feet from centre of shafts and at a less inclination than 45° from the horizontal, at a speed not under 2,000 feet per minute. Should the ropes be working vertically or at an angle greater than 45°, instead of taking 8 h. p. as the basis, you should take 7 or 6 respectively, according as the conditions grow worse and worse. On the other hand, should the ropes work horizontally and at a greater distance than 20 feet from centre to centre, and with a speed up to 3,600 feet per minute, and the pulleys be fairly large, say from 5 to 7 feet in diameter, you may take 10 instead of 8 as the basis." From these considerations the working strain may readily be determined. If, as before, we take $\frac{T_1}{P} = 2$, we find that under average conditions the allowable working strain will be $T_1 = 135\ d^2$ pounds. Under more favorable conditions and a higher velocity $\frac{T_1}{P}$ will be greater and T_1 will approach 200 d^2.

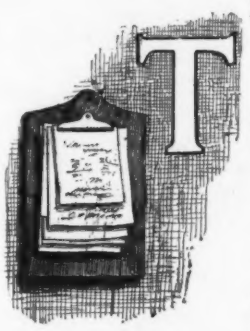
Although we have assumed the normal working load not to exceed 200 d^2 pounds, this must be considered as the economical load for the lasting qualities of the rope; in many cases, however, the first cost, the more convenient adaptation of smaller ropes, and the use and lesser cost of smaller pulleys outweigh the greater economy obtained by the larger ropes, and loads are carried far in excess of that given. By the use of a greater number of wraps the working load on each will be reduced, but this adds to the first cost of the plant and many concerns prefer to put in a new rope every year or two, rather than put in more or larger ropes every six or eight years.

*See paper by C. W. Hunt, Trans. A. S. M. E., Vol. XII., page 230.

(To be continued.)

Laboratory Notes.—XVI.

BY LIEUT. F. JARVIS PATTEN.



THE supposed pulsating character of the rotary field, it was formerly thought, would be materially improved if not entirely overcome by using many currents of different phases instead of two, because as we introduce more and more currents, then rectify and superpose them again, we find the resulting current $w\ w$, Fig. 39, approaches nearer to a straight line, and the difference between the maximum and minimum ordinates becomes less and less, but all this had nothing whatever to do with the rotary field effect, and as we shall see, three currents having a phase difference of 120 degrees or six currents having 60 degrees phase difference, or even 12 currents at 30 degrees difference, can in no wise improve the constancy and uniformity of the rotary field effect over that produced by two currents in quadrature. For to give a single illustration, suppose the triphase currents of Fig. 39 were introduced at the points 1, 2, 3 of the winding, Fig. 36. To determine their effect in this winding we lay off three axes, $X+X-$, $Y+Y-$, and $Z+Z-$, Fig. 40, and then proceed as before to lay off on these axes $X+X-$ and $Y+Y-$. The values of the ordinates of the curves of $x\ x$ and $y\ y$ of Fig. 39 and their resultant being found, it is combined with the ordinates of the curve $Z\ Z$ laid off on the axis $Z+Z-$.

Thus, to determine the points 1 and 2, Fig. 40, we lay the ordinate $a1$, Fig. 39, off on the axis $X+X-$, Fig. 40, in the positive direction, which gives us the distance $o\ b$.

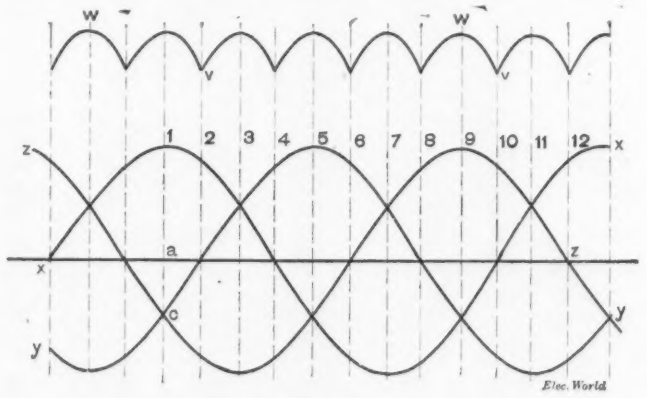


FIG. 39.

The ordinate $a\ c$, Fig. 39, belonging, as it does, to both $y\ y$ and $z\ z$ is laid off on both the axes $Y+Y-$ and $Z+Z-$ in the negative direction $o\ c$ and $o\ t$; through the extremities of these lines parallels drawn to $Y+Y-$, $Z+Z-$ determine the point a, which is the resultant of these two—it lies on $X+X-$—in the positive direction, and so must be added to the value of x previously found, $o\ b$, which gives the distance $o1$, and the point 1, as required. The other points up to 12 being plotted in the same way, we

shall find, as before, that they all lie on the circumference of the same circle, and that it is quite immaterial how many currents are used. The resulting magnetic effect is constant in its intensity with any number of multiphase currents, two or more, as long as the phase difference is an even divisor of 180 degrees and the maximum values of the currents are alike.

A pulsating effect in the rotary field is produced in an entirely different way, and may arise equally with two or

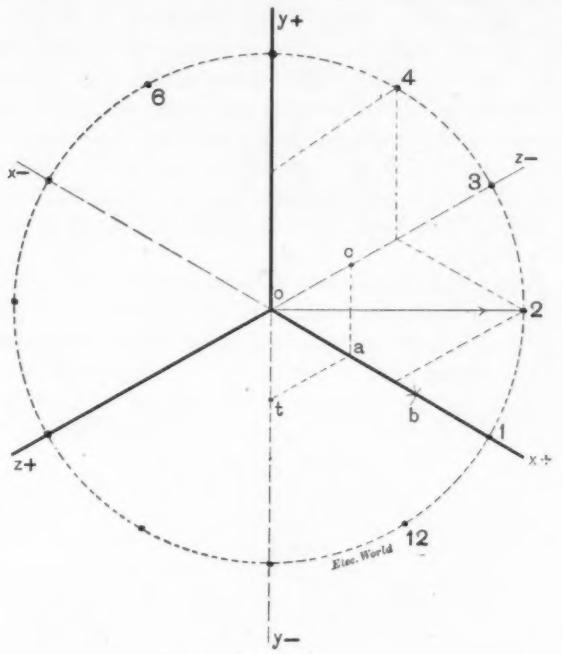


FIG. 40.

more currents. Thus, suppose one of the conditions named to be disturbed. Let, for instance, the two currents be in exact quadrature relation, but one as x x, Fig. 41, have a greater maximum value than the other. If, now, we plot the rotating field effect as before, we no longer obtain a

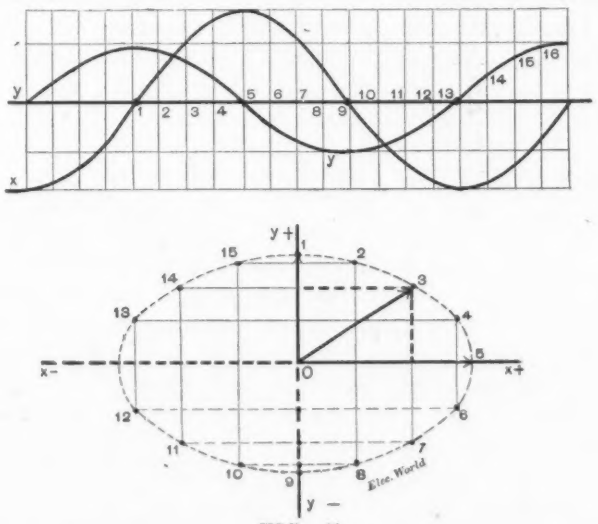


FIG. 41.

circle but an ellipse, which, of course, indicates a pulsating magnetic effect, the magnetism in the direction of the axis $X+X-$ being a maximum and in the direction $Y+Y-$ a minimum.

Currents in quadrature of different strengths give pulsating fields the greatest and least intensities, being coincident in position with the magnetic axes of the system.

Let us now suppose the two currents to have equal maximum strengths, but some other phase difference than 90 degrees—they are out of quadrature, as indicated in Fig. 42. We then find a pulsating field again, but one the greatest and least values of which do not lie on the magnetic axes of the system as before, but on diagonal lines, u u and v v, between these axes. The remaining case where the currents are

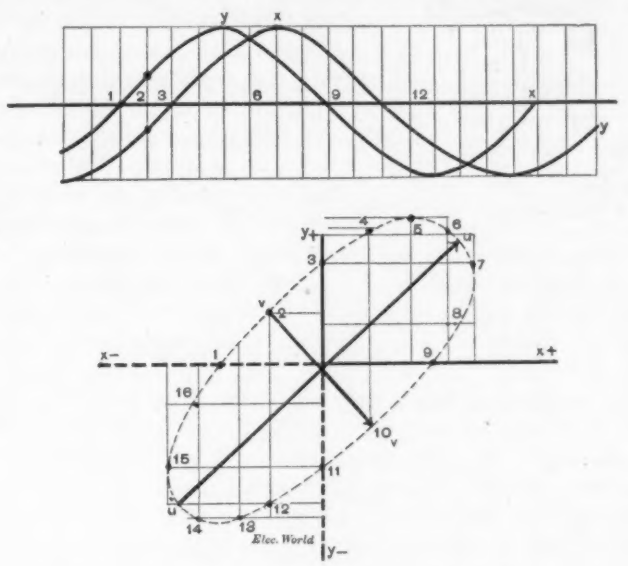


FIG. 42.

not only of unequal maximum strengths, but out of quadrature also, must necessarily give a pulsating field, having both the erratic characteristics of the last two cases considered. The case is indicated by Fig. 43, which is of course the extreme case for multiphase currents, as from it we pass naturally to the next step, which consists in the elimination of one of the currents altogether when we have the case of a single alternating current, and our ellipse indicating the

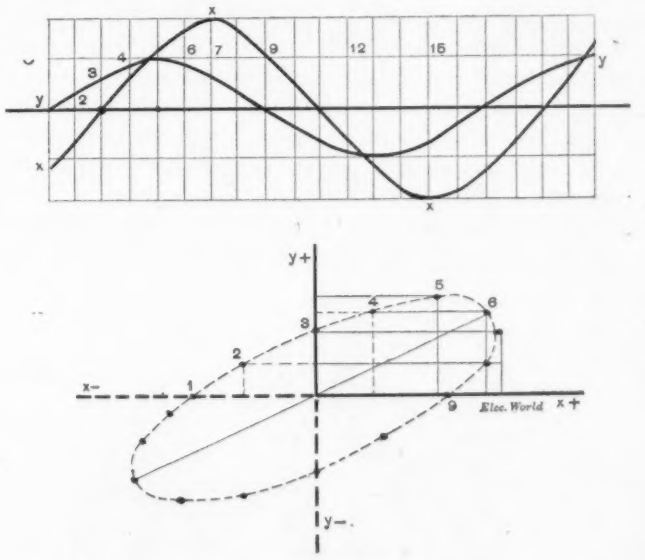


FIG. 43.

pulsating character of the rotating field is flattened down to a straight line, so that the field of the single alternating current is pulsating only without any variation from the right line action whatever, and may therefore be more accurately compared to a rapidly oscillating pendulum.

(To be continued.)

A New Departure in Electrical Journals.

Some of our foreign contemporaries are making a new departure by the introduction of colored illustrations. A London contemporary, for instance, starts its "Notes from Japan" with a colored illustration, apparently made by a native, representing "their special correspondent" in the act of writing, apparently with a spoon, and a box which contained what looks like blue and red rice.

The Calculation of Alternating Current Motors.—VI.*

BY E. ARNOLD.

THUS far I have made the usual assumption that the lines of force of the field form a rotary field of constant strength. The foregoing equations can, therefore, determine the behavior of the motor only when the above assumption holds good. I will now show in what follows that even without the adoption of such a rotary field the beginning of a torque and the starting of the motor can be explained.

At the time of the Exposition at Frankfort Mr. J. Sahulka had already drawn attention to the existence of secondary fields, or fields varying periodically, and considered their action harmful.

In every multiphase alternating current motor, with a magnetic field excited by an alternating current, there are present, according to my view, periodic magnetic fields, and in certain cases these are the predominant ones.

Under this assumption, the course of the lines of force corresponding to the momentary direction of the current is shown in Fig. 11. There are here present six periodic fields, whose lines of force link together single pairs of primary and secondary coils, and only a small part of the lines of force form a rotary field.

It appears from various phenomena that the periodic fields can be strongly formed. With certain arrangements of the primary and secondary windings, the pull with which the motor starts depends, for instance, on the relative position of these windings; in accordance with experience, it is even possible to have positions in which the motor not only develops no torque, but is also held fast.

The torque of a motor in which the number and position of the coils corresponds with the diagram in Fig. 11 will be almost nothing; if, on the other hand, the coils of the armature, A, lie between the field coils on the diameter $m_2\ m_2$, they are in a state of minimum activity, and the armature will be held fast in this position. Furthermore, it can be shown from multiphase motors which have been constructed that the torque is a maximum when running near synchronism, and from that condition falls away almost

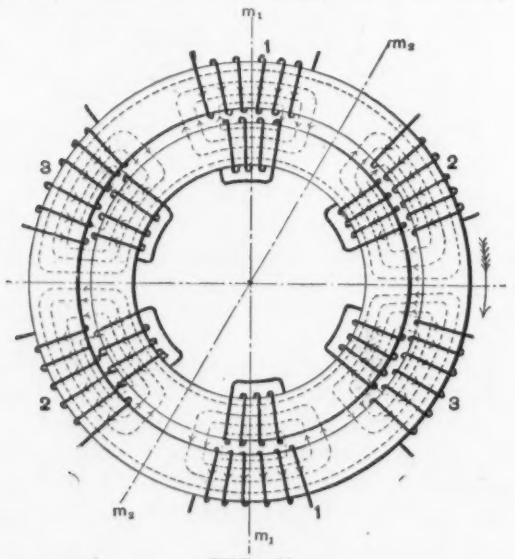


FIG. 11.

as rapidly as with single-phase motors. The slip which a motor suffers depends substantially on the arrangement of the field and armature coils, and on the resistance, R_2, of the latter. If the iron of the rotating armature be not laminated, it will become heated very rapidly, even when running nearly synchronously, while at complete synchronism and without this presence of periodic fields there would be no heating.

The appearance of dead points and positions of minimum attractive force can likewise be explained only through the existence of strongly developed periodic fields.

With a correct disposition of the field and armature coils, however, the periodic fields in the position of rest of the armature help to create a torque. Figs. 12, 13 and 14 serve to explain this assertion. The coils I., II. and III., in Fig. 12, belong each to one phase. We assume that no rotary field exists, but that each coil corresponds with a particular, periodically varying field. The space which the lines of such a field takes up grows with its intensity, and the field, which is increasing in strength, will supplant the weaker, or decreasing one. A large part of the armature windings will consequently be acted upon alternately by neighboring magnetic fields, and from this alternating induction there will result a torque.

In Fig. 12 it is supposed that the exciting current has reached its maximum value, I_1, in the coil II.; in coil I. its strength is diminishing, and in coil III. increasing; in both the latter the current, $i_1 = I_1 \sin 30°$. The field II., therefore, takes up the greatest space. After 1-12 of a period

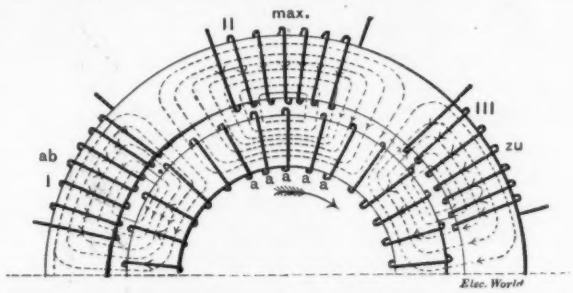


FIG. 12.

the strength of the current of phase I. will pass through zero, and in II. and III., $i = I_1 \sin 60°$. With the assumed direction of current, the diminishing field II. will induce currents in the armature windings, $a\ a$, which in their period lag behind the inducing E. M. F. by an amount equal to $\frac{\pi}{2} + \Phi_2$, and reach into the outspreading field of phase III. There is, however, an attraction between the currents, $a\ a$, and field III. Field I. is equal to zero, and consequently produces no effect. After the lapse of another 1-12 period the current of phase III. reaches its maximum in I. and II., $i_1 = I_1 \sin 30°$, and the current in I. has at the same time changed its direction. From the direction of the lines of force and the induced currents drawn in Fig. 12 it is apparent that the currents a, a, a, induced by field II. are attracted by field III. and repulsed by the outspreading field I. We obtain a torque which works in the same way as that generated by the assumed rotary field.

We need not enter into a discussion of the alternating actions between a periodic field and the currents induced by it; the attractive and repulsive forces cancel each other, and, as already shown for synchronous motors, the resulting torque exerted on the stationary armature is equal to zero.

The operations mentioned can be shortly summarized: A magnetic field, diminishing in intensity, induces, in the windings of the armature, currents which are either attracted or repulsed by the neighboring magnetic field of growing intensity, according as the magnetic fields concerned are opposed to each other or in the same direction. The attractive and repulsive forces act in the same way, and create a torque.

If the inducing currents follow the sinusoidal form, we can likewise represent the intensity of the magnetic field by sine

* For the last section of this article see The Electrical World, Dec. 30, 1893.

curves for low saturation of the iron. In Fig. 13 the curves I., II. and III. correspond to the three phases of the exciting current and show the course of the intensity of the

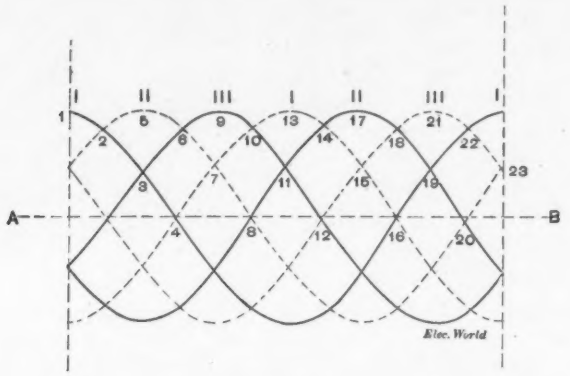


FIG. 13.

magnetism, as we represent the times by abscissae and the intensities by ordinates. By comparison of these figures it is found that when the magnetism passes through certain values either attraction or repulsion takes place, and so we have

between 5— 7 and 3— 9 attraction,
" 6— 8 " 4—10 repulsion,
" 9—11 " 7—13 attraction,
" 10—12 " 8—14 repulsion,
" 13—15 " 11—17 attraction,

and so on. It is apparent, from the overlapping of these times, that a torque of constant strength will be exerted on the armature.

The pulsations of the magnetic fields encroaching upon each other's space, together with a maximum which moves in a definite direction, suffice to explain entirely the starting of the armature with a torque.

With this, however, it is not denied that part of the lines of force really form themselves into a so-called rotary field. The intensity of the rotary field will depend substantially on the construction of the motor and the arrangement of the exciting windings. The six and twelve-coil windings designed by Mr. D. v. Dobrowolski favor the formation of a rotary field. It is even more essential, however, to plan the motor so that the interlocking of the periodic fields is promoted. This relation of the periodic fields to each other can be especially hindered or greatly weakened by the use of projecting teeth in the iron of the armature and the mag-

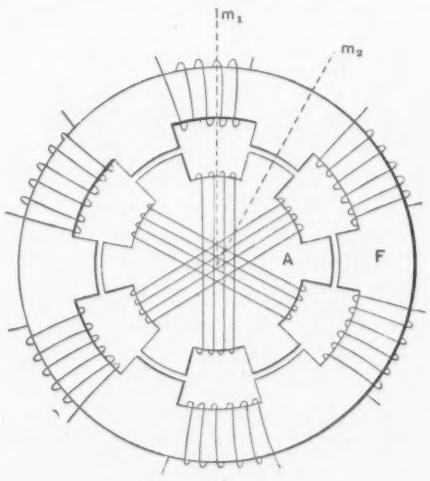


FIG. 14.

netic field in certain positions, and by an unfavorable numerical proportion of teeth.

In Fig. 14, for instance, the field and the armature are each provided with six teeth. In the given position of these projections the motor will develop almost no pull; it will behave like a one-phase motor. If we turn the armature through the arc $m_1 m_2$, so that the teeth of the armatu come between the projections of the field, the armature windings will arrive at the position of minimum induction and strive to keep in this place; the armature seems to be held fast in this situation. This condition of rest is more strongly developed, the smaller the resistance of the armature windings, for the endeavor to remain in the position of minimum induction grows and the scattering of the lines of force increases with decreasing armature resistance. If the armature be given an initial velocity, it will soon attain full speed, and the periodic fields now generate a torque, as in a one-phase non-synchronous motor. If, however, the number of projections and coils of the armature and field, as well as the armature resistance, be suitably chosen, the motor will start with a torque in all positions.

J. Sahulka has shown an arrangement which makes it possible to avoid the springing up of these secondary fields. In place of a ring with four pole pieces, two separate magnets are used, with only one alternating current flowing around each. That such a motor will develop little or no torque at starting follows from the statements already made. B. Kennedy, in The Electrical World, Dec. 10, 1892, page 372, published an account of an induction motor with a similar arrangement, and the results reached by it can therefore not be favorable.

The assumption that the lines of force which do not form a rotary field have a harmful influence is not well founded. If the motor be so built that the greatest possible number of armature windings are acted upon inductively by neighboring fields of different phase, and if the extended outspreading of the periodic fields be promoted, the greatest attractive power can be obtained.

Under the supposition that no rotary field is present, but

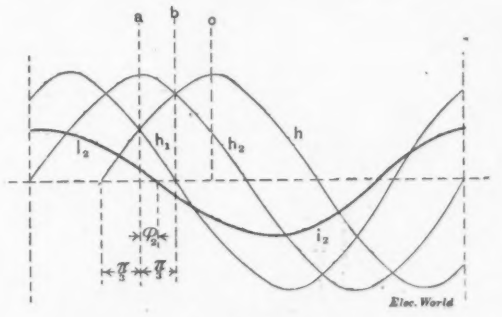


FIG. 15.

only periodic, or local fields, the amount of the torque generated is easily ascertained from Fig. 15. The sine curves, h_1, h_2, h_3, with a difference of phase of 60 degrees, are to represent the course of the periodic fields of the primary phases, I., II. and III. The E. M. F. induced in the secondary windings is a maximum when the intensity of the field considered passes through zero, and equal to zero when the field has reached its maximum intensity. The current, i_2, induced in the armature windings by the field, h_2, is consequently in a phase differing from h_2 by $90° + \Phi_2$. The course of the current i_2 is shown in Fig. 15. A torque will be created by the alternating actions between the neighboring fields, h_1, h_3 and the current i_2. This torque is proportional to the product of the maximum values of h_1, h_3 and i_2 and the cosine of the angle representing the difference of phase between h_1 and i_2, and h_3 and i_2, respectivelv.

Therefore, letting
I_2 represent the maximum value of i_2,
H_1 represent the maximum value of h_1,
H_3 represent the maximum value of h_3,
we obtain the torques

$$\tfrac{1}{2}\, I_1 H_1 f_2 \cos\left(\frac{\pi}{3} - \Phi_2\right)$$

and

$$\tfrac{1}{2}\, I_2 H_2 f_2 \cos\left(\frac{\pi}{3} + \Phi_2\right),$$

and as $H_1 = H_2$, the sum of both is equal to

$$\tfrac{1}{2}\, 1.73\, f_2 H_1\ I_2 \cos \Phi_2.$$

Now, $E_2 = 1.73\, p_1\, f_2 H_1$.

Therefore, when s_2 is the number of the secondary phases,

$$D = \frac{s_2}{2\, p_1} E_2\ I_2 \cos \Phi_2. \qquad (66)$$

As before, the torque is consequently equal to the energy induced in the armature divided by the angular velocity, p_1.

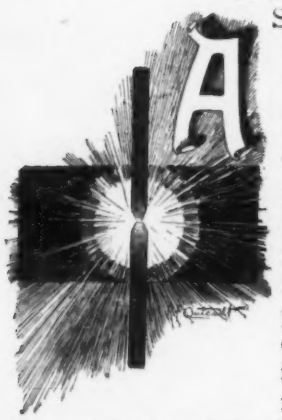
If highly prominent poles are avoided in a multiphase motor, and if the creation of a rotary field is favored in every other way, the periodic fields will not be strongly developed.

Under this supposition, the equations for the torque with rotating armature and the equation for the performance of the motor are to be derived.

(To be continued.)

The Theory and Design of the Closed-Coil, Constant-Current Dynamo.—III.

BY HENRY S. CARHART.



A SIMILAR series of experiments, made on an old Gramme machine of 3,000 or 4,000 watts capacity, built at the University of Michigan in 1876-1877, gave a different result. The measurements were made by simply connecting a third brush to the upper brush holder and measuring the potential difference between it and the main brush in different parts of the field. The actual induction to which the armature wire is subjected in different parts of the field and at the same distance of two commutator bars from the main brush is thus measured.

The following table contains one series of observations:

No. of observation.	Current in amperes.	P. D. between main brushes.	P. D. between main and third brush.
1	9.5	191	4.9
2	9.5	170	5.4
3	9.5	145	5.5
4	9.5	127	6.2
5	9.5	111	6.5
6	9.5	77	7.7
7	9.5	62	7.8
8	9.5	54	7.7
9	9.5	47	7.4

In this case the induction increases throughout the larger extent of the movement of the brush. But in this machine the knee of the characteristic curve is reached at about 13 amperes, while in the other machine it is found at 7 amperes. The armature reaction in this older machine, when run at 10 amperes, is relatively less than in the other one, run with the same current. This is further evident from the fact that with the old Gramme run at 10 amperes an increase in the current, due to lessening the external resistance, is always accompanied by an increase in the P. D. between the main and the third brush; while with the 10-light Sperry machine and others, with similarly saturated field, an increase in the current when the brushes are fixed decreases the P. D. between the main and the extra brush. The reason is this: If the field is saturated, but not the armature, an increase in the current does not appreciably increase the field, but it does increase the armature reaction, and so cuts down the total P. D. between the main brushes, as well as between one main and a third brush; while with an unsaturated field and a magnetically weaker armature, an increment of the main current produces a greater increment in the field than in the armature reaction. With the same old Gramme machine run at about 18 amperes an increment in the current produced a decrease in the P. D., both between the main brushes and the main and third brush. The armature reaction then became relatively larger than the increase in the field magnetism. But this old machine exhibits perfectly the property of governing by rocking forward the brushes on a diminishing load, with no more sparking in one position of the brushes than in another.

Hence, it is clear that for practically sparkless commutation it is not necessary that the induction near but under the brush shall be a constant. The effective means by which, with constant current, the brushes can be set in any plane round the commutator cylinder is the reactive effect of the armature. This fact is brought out quite clearly by plotting the integrated potential differences between the upper or positive brush and the third movable one as ordinates to a horizontal line. The data are the same as were employed to plot the first curve in Fig. 1. If Fig. 2 is examined a decided flattening in the curve will be found at 180 degrees, the position of the negative brush. The same flattening may be seen at 0 degrees. All curves plotted with data obtained at different loads show the same diminution or stay of the inductive process near the poles of the armature. The armature at these points paralyzes the field. As the poles of the armature move round they sweep away the lines of force of the field, and only enough remain to produce an E. M. F. competent to offset the E. M. F. of self-induction, and, in addition, cause the newly directed current to grow to its normal value as the coil passes out from under the brush.

This reactive power of the armature may be utilized to effect approximate regulation for constant current without brush shifting. But for this purpose the load cannot be a maximum. The poles of the armature must be far enough forward to produce increase of magnetic leakage. As an example of what I mean, a forty-light machine had its brushes locked in such a position that it maintained 30 lights with 10 amperes current. Ten lights were then cut off, and then ten more, with but small increase of sparking, and the ammeter showed an increase of current from 10 to 12 amperes only. A change of two amperes is within limits possible for practical lighting. The machine was then completely short circuited by placing a large bar of iron across its terminals without dangerous sparking. This means that the characteristic of the machine beyond a crown of the curve

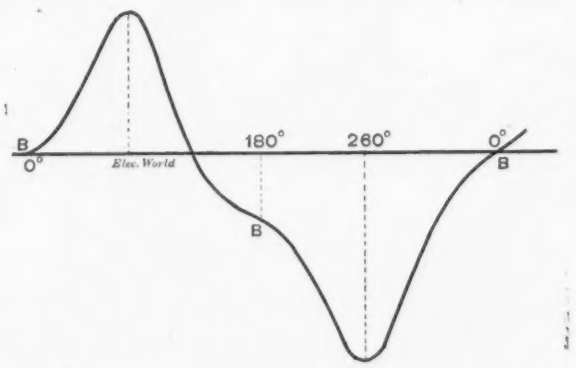


FIG. 2.

approached a vertical line, the ideal characteristic of an automatic constant-current dynamo.

The conditions requisite for sparkless comutation of a constant-current machine are therefore quite clearly defined. The self-induction of the short-circuited coils must nearly balance the field in all positions of the brushes. Both Mr. Esson, in a paper before the British Institute of Electrical

Engineers,* and Prof. Ryan, in a paper before the American Institute of Electrical Engineers,** lay down the condition that the brushes must be kept under the pole faces in order not to enter the weakened field between the pole corners. And yet I have seen constant-current machines working with the brushes beyond the extreme tips of the poles with no increase of sparking. I do not regard this condition as absolutely essential, since at maximum E. M. F. the brushes may be moved through a considerable angle without appreciable change in sparking.

Prof. Ryan states in his paper above referred to that "the magnetizing force impressed by the field ampere turns must be uniform at all points between the pole faces." This condition is favorable to sparkless commutation, but not essential. It has to do with the area of the sparkless position of the brushes for any given load. If the field is fairly uniform this area will be about the same in different parts of the polar faces; if the field is far from uniform, sparkless commutation may yet be secured, but a smaller variation in the current will produce more sparking than when the field is uniform; for the sparkless area on either side of the brush with a given external resistance is then much reduced. The region controlled by the armature poles is much more limited in extent than when the field is uniform.

It follows that the single magnet type of field is not suitable for a constant-current machine. This fact was remarked upon by Mr. Esson. For a two-pole machine the double magnet type of field is to be preferred. If then the iron is reduced at the back opposite the middle of the polar surfaces, and the poles are thickened and rounded off rather blunt at the ends to prevent saturation, the field induction will be sufficiently uniform without the necessity of resorting to the chopping away process applied to an English single magnet machine, described in Slingo & Brooker's "Electrical Engineering."

Quoting from Prof. Ryan, "The air gap is made of such a depth that the ampere turns required to set up the magnetization through the armature, without current, and for the production of the highest E. M. F. that the machine will be called on to give, shall be a little more than the armature ampere turns when it furnishes its normal current. Then as long as the brushes are kept under the pole faces the non-sparking point will be wherever the brushes are placed. This will be the case whether the armature is or is not saturated." Again, "The impressed field ampere turns are in excess of the armature ampere turns by that amount which is just sufficient to produce a weak positive field that will reverse the current in the coil when its terminal bars at the commutator pass under the brush." This latter statement appears to be borne out by the data given, but the machine experimented on was one giving a maximum of only 35 volts and 22 amperes, and its performance can scarcely be considered a sufficient guide for the design of machine required to furnish several thousand volts and a current of from 9.5 to 10 amperes. Again, I have known a 40-light machine converted into a 50-light without any change in the field whatever. The armature either contained more iron or was wound with a larger number of turns of wire. Both methods have been followed without effect on the sparking. The first method leaves the armature ampere turns the same; the second increases them 25 per cent. If the relation pointed out by Prof. Ryan holds in the first armature, it cannot also hold in the second, with such a meterial increase in the armature turns.

Further, if this relation does hold, there still remains unanswered the question of relative cross-section of iron in armature and field. Shall the core of the armature be saturated or not? Mr. Esson says that 17,000 lines per square centimetre is the best practice in England for constant potential machines.

I know of one constant-current machine in which the armature core is forced well up toward the highest saturation obtainable with a dynamo machine. It is able to produce very high E. M. F., but it does not govern sparklessly by means of a single pair of brushes. Two other types of machines of which I have data work with 11,000 lines per square centimetre in the armature. In both of these recent changes are along the line of increasing iron and decreasing copper in the armature. I have explicitly advised the use of more iron in the armature for two years. One manufacturer recently told me that he is now following my advice with most gratifying results. With the same number of turns on the armature the output is greatly increased. To what extent the iron in the armature can be increased is an open question. It has now been carried beyond a cross-section equal to 75 per cent. of the wrought iron in the field cores. If increased cross-section of the core introduces sparking, this can be avoided by increasing the number of bars on the commutator, so as to decrease the self-induction in the section under the short circuit by the brush. Indeed, if the output is kept the same, increase of iron decreases turns of wire, and to that extent decreases self-induction. In a machine with two pairs of brushes the effect is to diminish the angular embrace of each pair.

It is interesting to compare two machines of almost exactiy the same capacity, but differing widely in relative core section and armature turns. Let the two machines be represented by A and B. The data of the two are given in the following table:

Machine	Total volts.	Revs. per min.	Segments in commutator.	Turns per segment.	Total turns.	Cross-section of iron. Sq. in.	Lines per sq. in.
A.....	2,900	1,000	132	36	4,752	26.5	70,800
B.....	2,800	875	120	72	8,640	14.0	79,000

The maximum number of lines of force running through the armature of the A machine is 3,650,000; of the B machine, 2,213,000. The two machines are designed for the same current of a little under 10 amperes. The ratio of the ampere turns on the armatures of the two is nearly inversely as the cross-section of their iron cores. The ampere turns on the B armature are 82 per cent. greater than on the A armature. It is not probable that the field ampere turns on B are 82 per cent. in excess of those on A. Unfortunately, those particular data are lacking, but the magnetic circuit of A is quite as good as that of B. It does not appear at all probable, therefore, that Prof. Ryan's rule applies to both machines. It is gratifying to our national pride that American designers have successfully carried the Gramme ring constant-current dynamo to an output far beyond what some foreign electricians, with more theory and less practice in this direction, still declare to be impracticable. The writer of a series of articles now running in the London "Electrical Review"* says: "Beyond about 1,000 volts it is found, in general, to be impracticable to work a closed-coil armature; for either there will be a wasteful lead, or there will be vicious sparking under the brushes, or the current will flash from strip to strip, and will destroy the commutator." * * * "It seems more than probable that machines of this kind will not stand any serious alteration of load if worked at higher voltages, owing to the great range of lead which would be required, and the consequent sparking and flashing over." Again he says: "There is of necessity a large armature reaction in certain forms of arc light machines; and when this is the case the brushes would require to be shifted right into the centre of the pole arc before sparking would cease, if there were very many turns on each section. The wastefulness of this practice consists in the large number of back turns and cross turns which it involves." But in the face of such declarations as these a large number of American ma-

* London "Electrician," March 21, 1890.
** Proceedings, Vol. VIII., p. 465.

* "Electrical Review," Aug. 25, 1893.

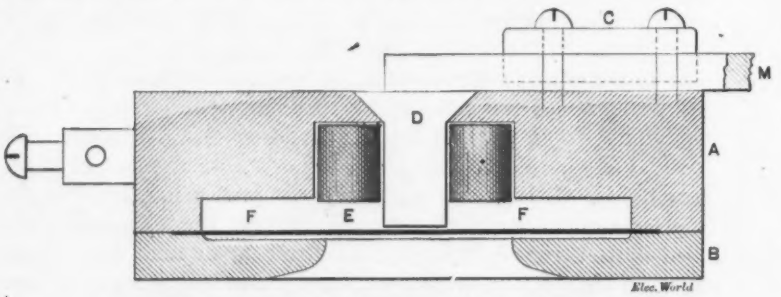
chines are now running at an output of 9.6 amperes and from 5,000 to 10,000 volts. A very considerable number of closed-coil Gramme rings giving 5,000 volts are in actual use without breakdown and without any of the fatal drawbacks predicted by the writer quoted.

The design of closed-coil Gramme rings for high potential arc lighting has thus far been limited to the two-pole type of field magnet. This involves the maintenance of higher speed than engineers find desirable. The conditions of present practice and the requirements for the immediate future demand a new departure in this class of dynamo design. All indications point toward a multipolar machine of about 50 kilowatts capacity and slow speed. The armature will contain a liberal amount of iron, much larger than would be found desirable for constant potential machines. Such a dynamo is already in demand, and it will find an immediate field for the lighting of large cities.

How to Make a Telephone.

The telephone of which we give detail sketches is simple to make, and will give excellent results on lines up to 5 or 10 miles in length, when used both as a receiver and transmitter. If used in connection with a transmitter, it will answer for any length of line. If the line is to be constructed in close proximity to electric railway or light wires, it should be made a metallic circuit, but elsewhere a grounded circuit will answer just as well.

The materials required for a set consisting of two telephones, one for each end of the line, are as follows: One-ounce No. 36 silk covered magnet wire; two horseshoe magnets, 4-inch; two flat-head stove bolts, 1-4 inch diam. and 1 1-2 to 2 inches long; a piece of photographer's tintype large enough to cut from it two round diaphragms 2 1-2 inches in diameter; four small wood screw binding posts; twelve flat-head brass screws 3-4 inch long. Use well-seasoned mahogany, or any hard wood, about 7-8 to 1 inch thick for the main case and for the cover that 1-4 or 3-8 inch in thickness is best. The pieces of wood should be larger than the dimensions given, and if marked and bored before sawing to the size desired, there will be less likelihood of splitting.



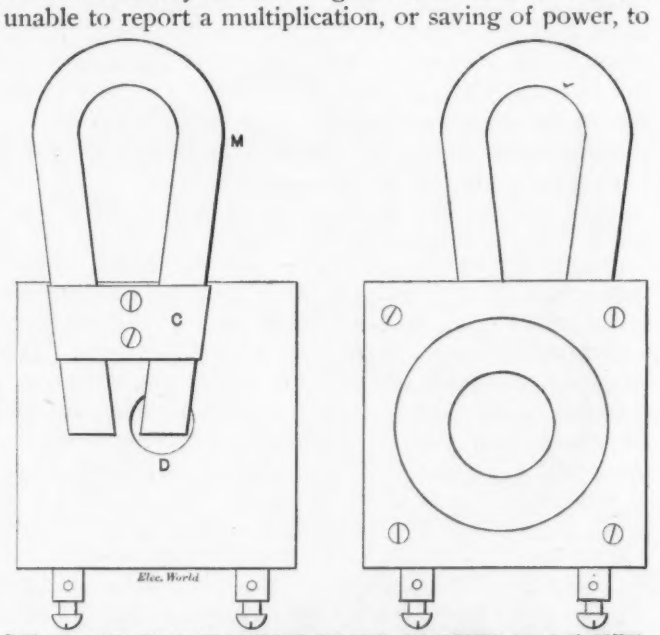
SECTION OF TELEPHONE, FULL SIZE.

Fig. 1 is drawn full size, from which the dimensions for the holes in the wood can be obtained. The 2¼ inch space under the diaphragm, *F*, can be bored with an extension bit or marked out with a compass and cut out with a chisel. The inch hole should be bored with a bit which has no lip in order to leave strength sufficient for countersinking the head of the stove bolts. The depression in the lid need not be as deep as shown, but merely enough to clear the diaphragm. The stove bolt should be cut to a length a little longer than necessary and then carefully filed and fitted by trial so that when in place it will just clear the diaphragm.

For the wire a spool should be made of cardboard to fit the bolt and central hole neatly; the spool with wire, *E*, is wrongly shaded in the cut.

The magnet is held in place, with one pole over the bolt head, by a piece of wood, as shown in Fig. 2 (half-size), the part between the legs of the magnet just clearing the bottom when the screws are home. The ends of the wire are brought to the binding posts through two small holes bored in the wood.

Magneto bells are the best and, in the end, the cheapest for use as call bells.



REAR AND FRONT VIEWS OF TELEPHONE, HALF SIZE.

Pennock's Misrepresentations.

To the Editor of The Electrical World:

Sir—My attention has been called to a circular issued by George B. Pennock, in which my name is unwarrantably used, and which, to say the least, is misleading. To a casual observer this circular would appear to be a report of an exhaustive test of the Pennock system of multiplying power by a "volt distributor," and assumes that I would be responsible for the statements and figures contained therein.

A more careful perusal of the subject, however, would reveal to the experienced engineer the real object of the author (to mislead), so there is little need of warning for those posted in such matters; but, for the benefit of laymen and would-be investors in electrical enterprises, allow me to say, through the columns of your paper, that I have never made a detailed report of the Pennock system for any one.

At the solicitation of a client I called at Mr. Pennock's laboratory to investigate the workings of the machine. After listening to Mr. Pennock's explanation of and claims for his crude apparatus, and taking several readings of the current output of his battery while doing various kinds of work, I was unable to report a multiplication, or saving of power, to any extent whatever by the use of the "volt distributor," much less to verify Mr. Pennock's large claims to economy.

Before seeing Mr. Pennock's apparatus, I suggested to my client that the electricians of the country condemned it as a fraud, though I visited the exhibit in Boston with a fixed determination to give due credit to any point of merit I might be able to discover.

My search for merit was fruitless, but a careful survey of the exhibit and of the methods employed by Mr. Pennock and his satellites confirmed the report I had heard of this system in other localities.

A hungrier set of parasites is seldom seen, seeking as their prey any one with money. The bunco steerer's vocation seems mild when compared with this.

In the circular referred to Mr. Pennock has arbitrarily assumed conditions and figures to suit his own convenience, but the facts in the case do not warrant a single conclusion in this truly wonderful document.

New York, Feb. 3, 1894. C. S. VAN NUIS.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM THE PRINCIPAL FOREIGN ELECTRICAL JOURNALS. BY CARL HERING.

(Note.—Owing to a delay in the transatlantic mails, most of the foreign journals were not received in time to be abstracted for this issue.—C. H.)

ELECTRO-PHYSICS.

Dimensions of the Absolute Temperature.—In an article in "La Lum. Elec.," Jan. 13, Mr. Abraham states that the quantity of electricity is proportional to and has the same dimensions as the ratio of the pressure of a gas multiplied by its volume and divided by the absolute temperature; by equating these and finding the value of the absolute temperature he concludes that the latter has the same dimensions as an electrical potential. He quotes from an adverse criticism of Mr. Ostwald, who claims that this result is absurd, on the ground that two magnitudes which are proportional do not necessarily have the same dimensions; to this criticism Mr. Abraham replies at some length. (In the Digest, July 22, Aug. 19 and Dec. 2, references and abstracts of other articles on this subject will be found.)

Electrostatic Charge at a Distance.—"La Lum. Elec." and "L'Elec.," Jan. 13, reprint in abstract a Physical Society paper by Mr. Hurmuzescu. If the knobs of an electrostatic machine be separated to a distance greater than the greatest sparking distance, and if one of them is replaced by a point, a gold leaf electroscope placed at one or two metres distant will show electrification; if the machine is then stopped and short circuited, the electrification of the electroscope will continue to show a charge, which will have the same sign as that of the point; if the point is negative this action will be greater; the transference, he says, is due to the convection by the molecules of air; if the knob of the electroscope is enclosed by an insulator and the rest of the apparatus enclosed in a metallic cage, this transference will no longer take place.

A Fundamental Error in Maxwell's Treatise.—The "Elek. Anz.," Jan. 14, publishes a paper by Mr. Schwartze, who has for some time been a contributor of mathematical articles in this journal; he claims to show that there is an error in Maxwell's treatise, which forms the foundation of many of his deductions; Laplace's formula, which, he says, is intended to express the relation between magnetism and electricity, is entirely incorrect; at present, he says, electricity is no longer considered as being matter, but is a form of energy; Maxwell's error, he states, lies in the fact that he places as equivalent the unit of the so-called dynamic magnetism quantity (magnetismusmenge) and the "so-called static electric quantity of the motive or electromotive force"; besides this, he claims that Maxwell overlooks entirely that magnetism is only the action of surfaces; in his opinion an isolated magnet pole is "scientific nonsense."

Atmospheric Electricity on the Eiffel Tower.—"L'Ind. Elec.," Jan. 10, reprints an Academy paper describing briefly observations made on the Eiffel tower; the mean was about 3,000 volts, while frequently it was above 10,000; a diagram is given of the diurnal variation for a certain day observed on the tower and in the observatory in Paris; it shows that the variations become simpler the greater the height; the minimum in the morning occurred at exactly the same hour, while the maximum in the evening was reached about one hour sooner on the tower. In order to be able to use a quadrant electrometer for measuring these high potentials without sacrificing sensitiveness, a number of small condensers, well insulated, are connected in cascade; by varying their number the potential at the electrometer may be made any desired fraction of the whole.

Atmospheric Electricity.—"La Lum. Elec.," Jan. 13, refers briefly to Mr. Lechner's observations regarding the St. Elmo fires, the object of which was to observe the sign of the electricity; it was found variable, especially during storms, but in general it is more often negative in winter than in summer; when the snow is in large flakes it is positive, while when in small flakes it is negative.

Dielectric Constants of Biaxial Crystals.—The article by Mr. Borel is continued in "La Lum. Elec.," Jan. 13; he discusses the measurements of the constants by Boltzmann's method of attraction.

MAGNETISM.

Forces Acting on Bodies in Magnetic Fields.—"La Lum. Elec.," Jan. 13, reprints a mathematical paper by Mr. Vaschy on the calculation of the forces to which bodies are subjected in the electromagnetic or magnetic fields.

DYNAMOS AND MOTORS.

Experiments with Brown Non-Synchronous Motors.—The same article which was abstracted in the Digest Jan. 20 is published also in "La Lum. Elec.," Jan. 13, in which is given in addition a diagram showing the complete connections of the motor and the starting devices.

Irregularities in the Action of Dynamos.—The article in "L'Elec." is continued in the issue of Jan. 13.

ARC AND INCANDESCENT LIGHTS.

Alternating Arc With and Without Reflector.—In "L'Ind. Elec.," Jan. 10, a set of curves is given for an alternating arc lamp, with and without a reflector; the reflector is horizontal and placed immediately above the arc; the maxima were 550 c. p. without and 912 with reflector; the mean spherical illumination was 275 c. p. without reflector, while the mean hemispherical illumination was 498 c. p. with reflector.

Fredeureau Diffusers.—The article in "L'Elec." by Mr. Haubtmann is continued in the issue of Jan. 13, and is devoted entirely to a discussion of the optical principles.

Electric Lighting in 1803.—The "Zeit fuer Elek.," Jan. 15, quotes from a German newspaper dated Jan. 3, 1803, mentioning that a locksmith named Probst had generated electric light sufficient to illuminate a whole room; the description is vague, but the light appears to have been generated by sparks, or some form of high-tension electric discharge.

ELECTRIC RAILWAYS.

Locomotion in London.—Mr. Graff Baker in London "Lightning," Jan. 11, advocates the construction of overhead electric railways on single columns, running through the vacant spaces at the backs of buildings, between two parallel streets on which the buildings face; he advocates single lines, preferably in the form of a loop, entering the city by one route and leaving by another; the arches where

the line crosses the street could be made quite ornamental, as these will be the only places where the line will be visible; the cost of such railways, he claims, would be far lower than that for any other means of locomotion; as an alternative, he suggests a system of light railways running below the surface of the ground in an open cut, 10 feet wide and 16 feet deep, running like the other between the backs of buildings.

A New System of Electric Traction.—According to the "Zeit. fuer Elek.," Jan. 15, certain firms are about to introduce a new system, in which the cars are hung on the tracks which convey the current; the first road to be constructed is one from Barmen to Elberfeld across a river.

Cost of Traction.—"La Lum. Elec.," Jan. 13, gives a few figures regarding the cost of traction; for horse traction in Paris and Frankfort, about 19 cents per car mile; several other horse lines in Paris, about 16 cents; for locomotives without boilers, 14.5 cents; for horse lines in Rouen, 13 cents; for compressed air at Nantes, 11 cents; and for electric traction at Frankfort, 9.6 cents.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Alternators in Parallel Driven by Gas Engines.—Mr. Roux in "L'Ind. Elec.," Jan. 10, discusses the question of driving dynamos by means of gas engines, stating that when alternators in parallel are used it would not be satisfactory if they are run independently; in such cases they should be coupled with each other rigidly, and in case an additional machine is added to the station at a future time, one should be careful to see that it is a machine of the same type.

Gas Engines in Electric Lighting Stations.—"La Lum. Elec.," Jan. 13, publishes the first part of an article by Mr. Bourquin, in which he discusses at some length the subject of gas engines, incandescent lights, the combination of the two, and gas lights; it appears to be based on papers already mentioned in the Digest, Oct. 14 (Hoest) and 28. The costs under various conditions are worked out, based apparently on prices in Paris.

Gas Engine Test.—"La Lum. Elec.," Jan. 13, publishes a test by Mr. Witz of a Crossley gas engine in an electric lighting installation.

Cologne and Amsterdam.—"L'Ind. Elec.," Jan. 10, gives an illustrated description of these two stations.

WIRES, WIRING AND CONDUITS.

Increasing the Safety of High-Tension Alternating Currents.—The "Bul. de la Soc. Int." for December publishes in full a paper by Mr. Claude, read before that society, on his method, which consists essentially in connecting a self-induction between the cable and the ground; the method was described in the Digest Dec. 16 and 23; in the present paper it is described more fully than in the previous publications. In the discussion which followed Mr. Arnoux said that it was not certain that this would reduce the current sufficiently to make it safe, and that nothing less than a practical test would determine this; with the usual alternating currents, he believes that danger ceases when the current through the body is below about 0.01 ampere; in his reply Mr. Claude claims that even though it has not been proved by an actual test that this device is sufficient, yet there is no need to prove that the danger is at least lessened thereby.

Impedance of Aerial Lines.—"L'Ind. Elec.," Jan. 10, contains an article on this subject by E. H., based on the paper by Mr. Kennelly on "Impedance" (transactions of A. I. E. E., April, 1893, reprinted in abstract in The Electrical World May 6), in which the impedance factors are given; that is, the factors by which the resistances must be multiplied to give the impedances or apparent resistances; in the present article the factors for a frequency of 100 are reproduced, and the following rule is given for deducing from these the factors for any other frequency: Square the impedance factor, subtract one, multiply by the square of the new frequency, divide by 10,000, add one, extract the square root; the result will then be the new impedance factor.

Fireproof Insulation.—In the "Zeit. fuer Elek.," Jan. 15, the following flexible cement, invented by Mr. Snedekor, is given; it is used for painting wires and is said to be a fireproof insulator; the proportions by weight are about as follows: Forty magnesia, 28 tallow, 15 pulverized asbestos, 30 liquid glue, 15 glycerine and 1-4 chromate of soda or potassium; to this may be added an additional 1-4 of lampblack if it is desired to make it black.

Conduits.—"La Lum. Elec.," Jan. 13, describes and illustrates the molds for the manufacture of the Crumpton and Chambers multitubular conduits.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Accumulators in Telegraphy.—According to an abstract from "Ann. Teleg." in the "Bul. de la Soc. Int.," the French Telegraph Department has decided, after a long series of experiments, to adopt accumulators almost exclusively for the central station at Paris; the auxiliary apparatus is described very briefly.

ELECTRO-CHEMISTRY.

Purification of Sewage.—"Cosmos," Jan. 20, publishes part of a report of a commission appointed to examine the Hermite process at Havre; the report is unfavorable; it is claimed that the action is not sufficiently rapid for completely sterilizing the materials before they are discharged into the river, and therefore does not furnish sufficient guarantee for prompt disinfection; it shares with other chemicals the property of deodorizing the material, in which respect it has a certain utility.

Copper Baths.—Dr. Langbein in the "Zeit. feur Elek.," Jan. 15, states that in dissolving the copper sulphate in cyanide of potassium, if sulphates and ammonium, potassium or sodium hydrate be added, it will prevent the cyanogen from escaping; he has found that in that case not a trace of cyanogen escapes; such baths give very dense, strong and hard deposits.

Combination of Phenol and Iodine.—According to the "Zeit. fuer Elek.," Jan. 15, a German chemical firm produces the combination by electrolyzing an alkaline solution of phenol mixed with iodide of potassium; in this way the drug aristol may be produced at the positive electrode.

Libbey Battery.—From a short illustrated description in "La Lum. Elec.," Jan. 13, this consists of a disc of zinc and one of copper, separated by a sponge in the form of a disc, the whole being held together by means of a bolt and an envelope of porcelain, having a hole for the introduction of the liquid.

Theryc & Oblasser Accumulator.—A short illustrated description is given in "La Lum. Elec.," Jan. 13. It consists essentially of the usual plate enclosed in a perforated envelope of celluloid.

MISCELLANEOUS.

Electric Welding in 1851.—In an article by Mr. Andreoli in "La Lum. Elec.," Jan. 13, after a brief reference to galvano-plastic soldering in 1850, he quotes at some length from a French patent of Derode, No. 13,716, dated 1851, which describes a method of welding in which electricity is applied in addition to the heat of a furnace; Derode shows the advantages of using electricity and ascribes its action to its heating effect, its chemical effect and to its magnetic effect; regarding the latter effect, he believes that the magnetic attraction separates the iron from the carbon, thus increasing the ease of union of the iron; the current is applied in the form of "shocks" in rapid succession; to show its effect, he heated some pieces of cast iron in a furnace and found that by applying an electric current they were immediately lique-

fied; he also found that there was less oxidation; he claims to have welded pieces of cast iron, which, on being afterward fractured, did not break at the joint; he also welded steel to iron for tools like picks; he also covered cast iron with lead. In applying the process to soldering, he finds that the solder is more easily melted and combines with the metals better when a current is used. Mr. Andreoli claims that Derode should, therefore, be given the credit of the origination of electric welding. He also describes experiments of Napier, made in 1844, in which the electric current was applied to electro-metallurgical processes, showing that the action may be hastened by the aid of a current.

Lightning and Trees.—"L'Elec.," Jan. 13, publishes from another paper the results of experiments made by Mr. Dimitrie, in which he subjected different pieces of wood to the sparks from a Holtz machine and found that they conducted quite differently; oak was easily pierced, while beech was quite resisting; the richness in water did not seem to have any influence, while the amount of oil contained was of great importance; woods containing starch and but little oil, like the oak and poplar, have much less resistance than those containing oil, like the beech; pine contains oil in the winter, but is very poor in oil in the summer, when it resists only as much as the oak; by extracting the oil with ether, the woods are as easily pierced as those containing starch; those containing starch are less easily pierced when living than when dead; the bark and the foliage in all the trees are poor conductors. The conclusions are in accordance with observations, as in a certain case 159 oaks were struck by lightning as against 21 beech and 59 pine trees; the danger of being struck as compared with beech is 5 for Norway pine, 33 for pine and 48 for oak.

Ozone.—According to abstracts in "La Lum. Elec.," Jan. 6, of articles from "Rev. Scien." and "Ann. de L'Int. Pasteur," Nov. 25, antiseptic action of ozone ceases when the volume of ozone falls below 0.1 per 100 of air; in a vessel containing 0.5 mgr. per litre, which mixture has a strong odor and can be breathed only with difficulty, cultures of microbes were not affected, while milk and fruits putrefied as easily as in the air; it is stated that it loses its disinfecting property if the proportions are less than 0.05 per 100 in volume, which prevents it from being used in dwellings, as the air cannot be breathed if the proportion is greater.

Lessons from the World's Fair.—In an editorial on this subject the Lond. "Elec. Rev.," Jan. 12, refers to the Fair, using the words "big" and "biggest" very freely, and stating that "only in one thing it was not big, and that was as an exhibition of the science and art of electricity and electrical engineering, from a European point of view"; but this, it says, does not refer to Americans, for whom "this show has, for the first time, brought the advanced state of electric lighting and electric power before the notice of thousands, who, prior to their visit, had only dim notions of the various developments" (!); "from the European point of view, the electrical exhibits were of little or no interest, and therefore as an exhibition we consider it was a failure."

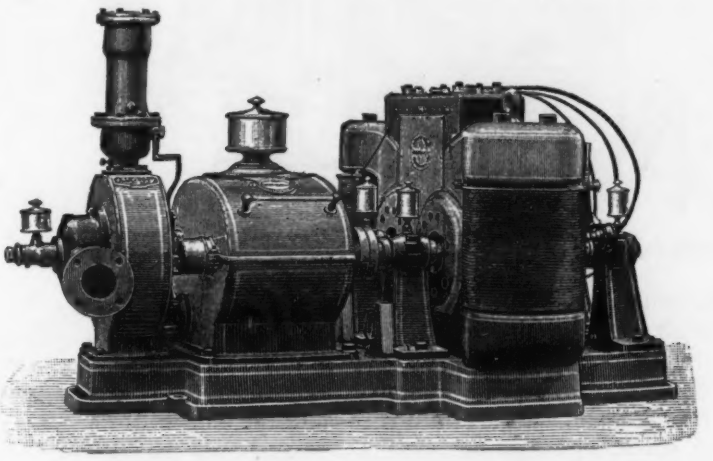
Graphics.—In "Lightning," Jan. 11, Mr. Harrison gives the first part of an article intended to assist those who are discouraged by imaginary difficulties from reading very simple papers on electrical engineering; the idea is not to teach graphics but to teach one how to read graphics.

Electric Language.—"L'Ind. Elec.," Jan. 10, contains an article by Mr. Picou under this heading, in which he points out the importance of using correct expressions regarding electrical subjects, in legal and other like documents.

National Laboratories.—Mr. Guilbert in "L'Ind. Elec.," Jan. 10, discusses the subject of national laboratories for researches.

The De Laval Steam Turbine.

The steam turbine we illustrate, of which Wiley & Phelps, 1,422 Monadnock Building, Chicago, are agents, is in principle similar to the well-known axial jet turbine for water, being so arranged that the steam has acquired the same pressure as the surrounding atmosphere before reaching the turbine wheel. The steam then passes between the blades of the turbine at a constant relative velocity and in a clear jet, without any disposition to further change its pressure or specific gravity. Consequently the movement of steam in the turbine is according to the same laws as for water, and the blades of the turbine can therefore be constructed in the same manner as if designed for water. The expansion of steam takes place in the nozzle, and is caused simply by making its sides diverging. As the steam passes through this channel its specific volume is increased in a greater proportion than the cross-section of the channel, and for this cause its velocity is increased, and also its momentum, till the end of the expansion at the last sectional area of the nozzle. A pressure of seventy-five pounds and expansion to an absolute pressure of one atmosphere give a final velocity of about 2,625 feet per second. The momentum being as the square of the velocity, it is evident that although the density of the steam is small, the impact will be considerable at the enormous velocities which are obtained.



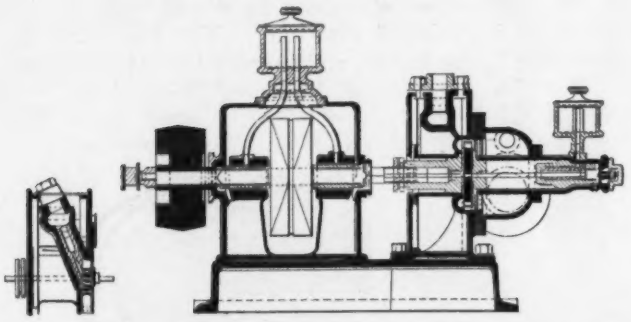
COMBINED STEAM TURBINE AND DYNAMO.

Since expansion is complete, it is evident that all necessity of tightening against steam pressure ceases at the end of the nozzle. And since live steam does not come in contact with any of the working parts of the turbine, the machine operates equally as well with superheated as with saturated steam, thus furnishing an opportunity for economizing heat which is impossible in ordinary steam engines on account of the sensitiveness of the packing boxes to temperature.

The most characteristic feature of the De Laval steam turbine is perhaps its great speed, the velocity of periphery in the 5 h. p. being 574 feet per second. De Laval has succeeded in solving the problem introduced by this high speed by providing the turbine with a flexible shaft. This yielding shaft allows the turbine at the high rate of speed to adjust itself and revolve around its true centre of gravity.

With such high speeds great power can be obtained from small apparatus. The 20-h. p. turbine is only 6 1-2 inches in diameter, 5-8 inch thick and mounted on a shaft which is less than 1-2 inch in diameter. The shaft is long and the bearings on each side of the wheel are far apart, besides which the shaft is reduced in diameter between the wheel and the bearings to give flexibility. In the gearing box the speed is reduced from 30,000 revolutions to 3,000 by means of a driver on the turbine shafts, which sets in motion a cog

wheel of ten times its own diameter. These gearings are provided with spiral cogs, carefully cut and placed at an angle of about 45 degrees. On account of the high velocity, all tensions caused by the transmission of power are very slight. Consequently the cogs can be quite small, which is one of the conditions for even running of the gearing. The governor is attached to the inner end of the shaft of the large cog wheel, and is of new and original construction. The frame is provided with a slightly conical pin, by means of which the governor is held in a corresponding hole in the shaft. The segment weights or wings are movable on edges, thus with the least possible friction. When the governor revolves the weights diverge, their inner ends push a pin forward, and this pin in turn causing the cut-off of the valve. A spiral spring is enclosed in the governor and keeps the weights in a state of equilibrium at the desired speed. The governor is enclosed in a metal box to protect it from dust. By means of a lever the movement of the governor pin is transmitted to the governor valve.



NOZZLE AND VERTICAL SECTION OF DE LAVAL TURBINE.

Oil for lubrication is furnished from the two oil cups shown. In the lower part of the gearing box waste oil from the four bushings collects, as also oil from the cog wheels. It is drawn off by means of a small cock.

The turbine is manufactured from the best quality of steel, the blades are cut in one piece with the body of the turbine by means of a milling machine. A steel ring is then shrunk on outside of the blades. This ring prevents the steam from passing over the ends of the blades, and removes the tendency of the turbine to act as a fan.

The practical advantages which characterize the steam turbine as against the oscillating engine are: Simplicity of construction, very small passive resistance, small space, small weight, and a very regular speed. This last property is a consequence of the continuous admission of steam to the turbine wheel, and the equalizing effect of the rapidly revolving parts of the engine. Furthermore the governor is here in readiness for instant effect on a variation of the load, and does not, as is the case with piston engines, have to wait until the slide valve admits steam to the cylinder next time.

The economy of this steam turbine is proved by numerous tests, of which one lately made, it is claimed, by the best engineering experts, with a 50-h. p. turbine dynamo showed that an effect of 63.7 h. p. was obtained with a consumption of steam of 8.05 kg. (= 19.73 pounds) and a consumption of coal of 1.12 kg. (=2.67 pounds) per horse power per hour.

A Modern Power House.

We illustrate an interior view of the power house of the Worcester Traction Company, Worcester, Mass., which, including the traveling cranes, was designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn. The power house is 93 feet in width and 120 feet in length; the engine room, which we illustrate, is 47 feet in width, the boiler house, which is alongside, being 73 feet wide. The whole floor space of the engine room is controlled by a traveling crane which allows all the machinery to be easily placed or moved from one part of the building to another, or, in case of repairs, allows the parts to be handled quickly and economically.

The frame work of the building is entirely of steel, the side walls being of brick placed between the steel columns. A power house constructed in this way is absolutely fireproof, and there is no reason, it is claimed, why any company with such a building should carry insurance, as the risk of fire is reduced to an absolute minimum. The manner in which the traveling crane facilitates the handling of machinery will be in particular appreciated by superintendents of power stations. This modern style of structure is rapidly finding its way into popular favor and fast replacing the inferior wooden buildings for light and power stations.

INTERIOR OF MODERN POWER HOUSE.

Cutter's New Pole Pulley.

Encouraged by the success of his swivel pole pulleys, George Cutter, The Rookery, Chicago, has now brought out a new form, which promises to become even more popular than the old one. To secure an ordinary pulley to a pole in such a way that the rope will not chafe against the edge of the casing is not so simple a problem as it would seem at first thought. For this reason Mr. Cutter came out a few years ago with a pulley which was swiveled on a special pole screw and which would always swing into line with the hoisting rope. This form has been used extensively throughout the country, and with excellent results, the saving in the wear of the rope being quite noticeable.

IMPROVED POLE PULLEY.

As the cut shows, the new type has the same style of sheave with weather-proof casing, the change being in the support, which is in the shape of a malleable iron wall plate. This plate can be readily secured to the pole by means of two lag screws, making an extra strong and rigid support.

The Shawhan-Thresher Dynamo and Motor.

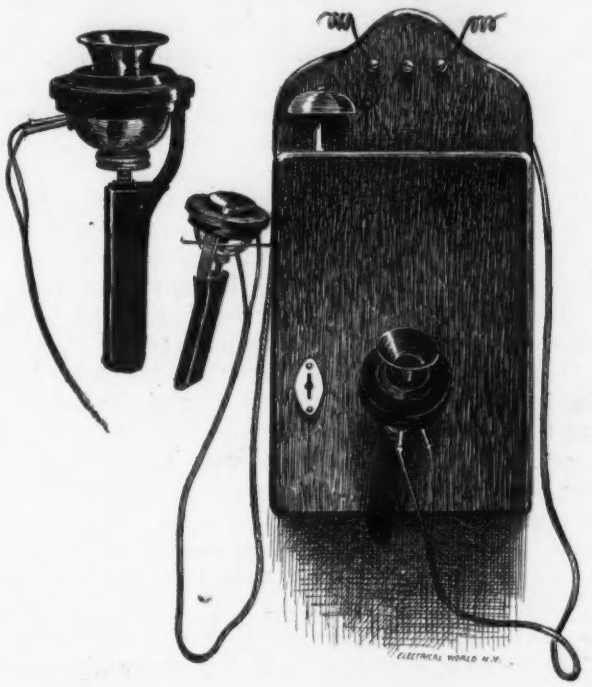
One of the latest and most interesting claimants for attention in the electrical field is the Shawhan-Thresher dynamo and motor, manufactured by the Shawhan-Thresher Electric Company at Dayton, Ohio. We give herewith a good view of this machine, from which it will be seen that it is of the ironclad type. The parts are so proportioned as to afford absolute protection to the field coils and give perfect ventilation, while the magnetic material is so placed as to correspond with the theoretical blow of magnetic induction, thus forming one of the best designs for a field and giving a high efficiency.

Two castings are employed, the journal boxes being cast solid to the lower one. This gives unusual strength and rigidity, and brings the centre of gravity very low, insuring great steadiness in operation. The bearings are self-oiling and self-centring, universally supported. The armature is of the drum type, exactly balanced and so wound that the coils of highest potential are farthest apart. This feature lessens the liability of burn-outs.

The machine is strong, compact and all parts are easily accessible, and is made in all sizes from 1-2 h. p. upward. The same company is also making a power generator of the multipolar type.

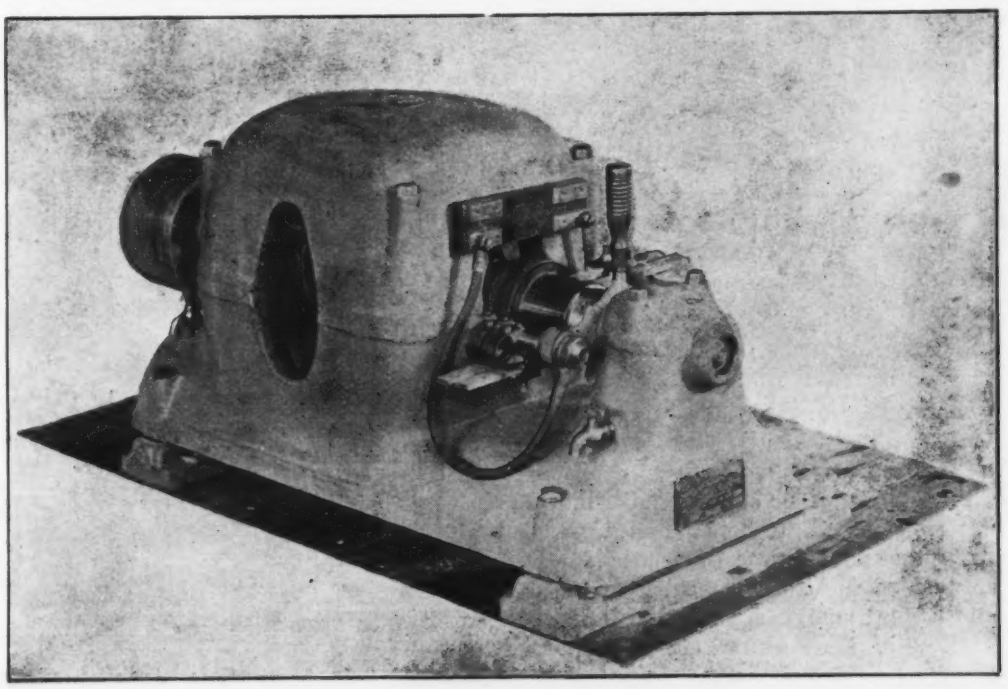
The Brown Magnetophone.

The efficiency of the Brown magnetophone, manufactured by the Brown Telephone and Telegraph Company, Chicago, appears to depend upon a -shaped magnet and the manner in which it operates upon the diaphragm. It is claimed to differ in function in one very important particular from the bar magnet, so generally employed in the telephonic art. As is well known, the bar magnet is placed with one pole opposite the centre of the diaphragm, upon which it exerts a strong attractive pull inward toward the pole of the magnet. As this pull is constant, it operates to lessen the freedom of the vibration of the diaphragm much the same as would a weight suspended by a string from its centre. Now, as the efficiency of the diaphragm depends upon the freedom and amplitude of its vibrations in the electrical field, created by the magnet, it follows that its efficiency is decreased in exact ratio to the strength of the inward pull which opposes these vibrations. It is this obstructive action on the diaphragm which rendered



THE IMPROVED BROWN MAGNETOPHONE.

the transmitter and receiver covered by the letters patent granted to Alexander Graham Bell Jan. 30, 1877, and now just expired, of no practical commercial utility until the invention of Berliner, with its carbon patents and battery cur-



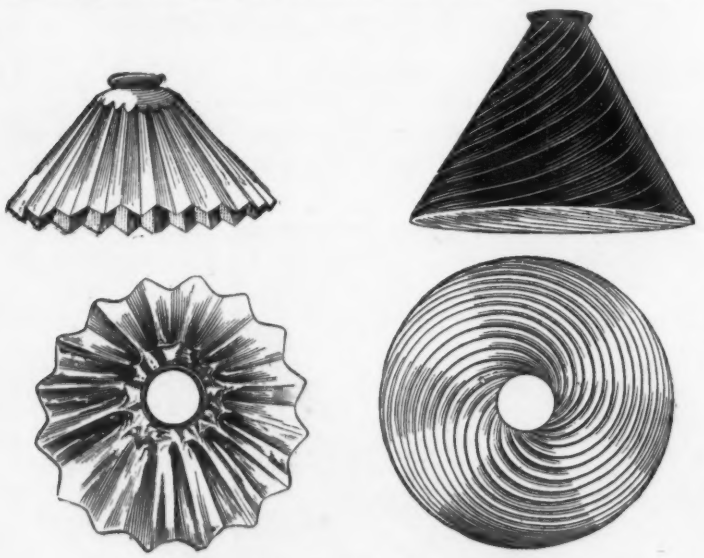
THE SHAWHAN-THRESHER DYNAMO AND MOTOR.

rents, was engrafted upon them, and which give to the Bell system its present efficiency. Berliner, however, does not by this method remove the inward pull of the magnet on the diaphragm, but employs means to largely overcome its injurious effects. Brown, however, has proceeded upon a distinctly different theory than that of Berliner. His object has

been to so employ the lines of magnetic force as to neutralize the inward pull, so obstructive and hurtful in the bar magnet. Referring now to the Brown magnet, we find that the end presented to the diaphragm is divided into two arms, creating poles of the same polarity, one of which is placed in actual contact with the diaphragm at a point on its periphery and the other near and opposite its centre. As the lines of magnetic force emanating from these poles under the laws of electricity must repulse each other, the pull upon the centre of the diaphragm is now not all one way, for the attractive force of the centre arm of the magnet is in part neutralized by the lines of force emanating from the side arm. Such is the theory, and the facts show that the diaphragm is so relieved of the inward pull at the centre as to be free to respond to the slightest vibrations of the voice in speaking; it being practicable, so it is claimed, to communicate, with its use, in whispers. Brown's method, as above imperfectly presented, will, it is believed, prove of some interest to electricians. The economic results claimed for it are also important. It obviates the use of the battery and gives to the magneto type of telephone long-distance carrying power. Being apparently free from infringement of the Berliner patent, it is also of interest to the public in its promise of wholesome competition.

Silvered Glass Reflectors.

The E. P. Gleason Manufacturing Company, Houston and Mercer streets, New York, which is constantly adding to its already large line of appliances for electric lighting, is now in the market with a number of new styles of silvered reflectors, as shown in the accompanying cuts. They are made in shape of the staple electric shades, radial fluted and spiral corrugated, richly silvered inside, enameled green outside, greatly increasing the candle power of electric lamps. The reflectors are always bright, cannot tarnish and are easily cleaned, and another advantage is that they can be made cheaply.

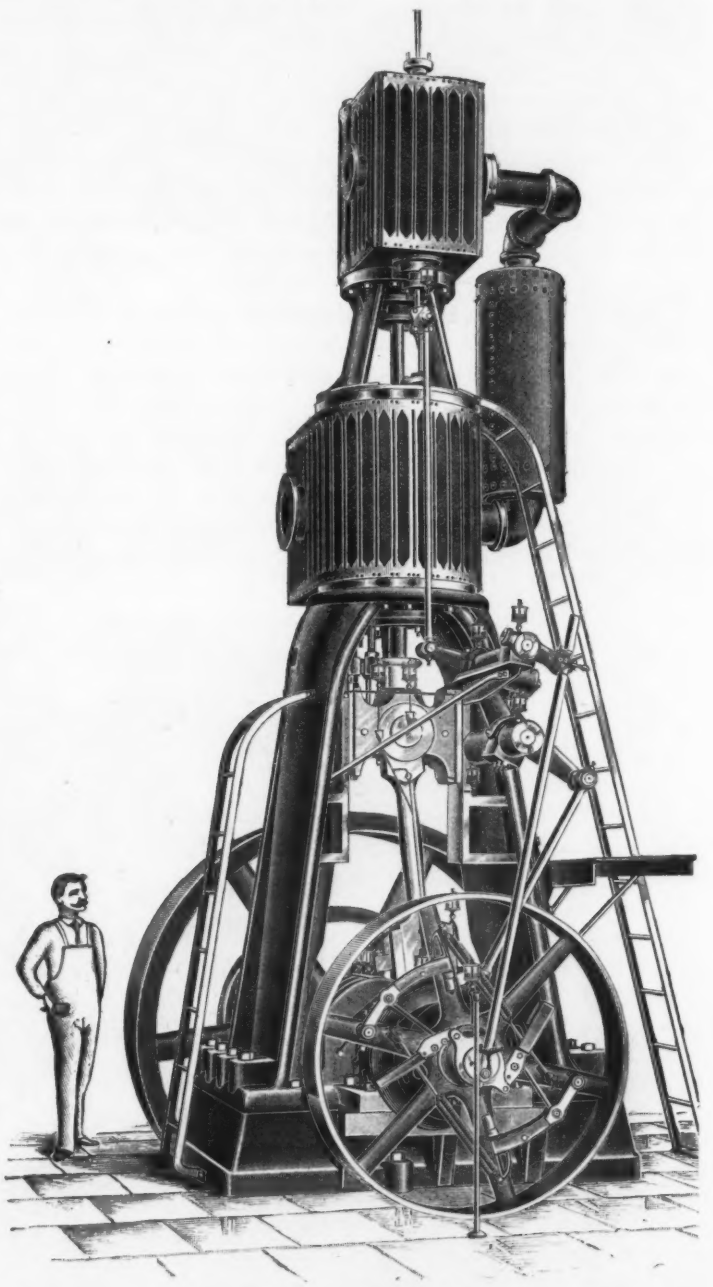


SILVERED GLASS REFLECTORS.

A Vertical Compound Engine.

The engine illustrated herewith is one of a pair which was built expressly by the Fitchburg Steam Engine Company, Fitchburg, Mass., for electric light and power use in Oakland, Cal. It has a high-pressure cylinder 16 inches in diameter, a low-pressure cylinder of 27 1-2 inches, with a 20-inch stroke, and making 210 revolutions per minute. These engines are run under 130 to 140 pounds pressure, and will develop easily 350 to 400 h. p. The valves used are the special patented expansible valves used in all the engines built by this company, which are balanced and adjustable to take up all wear during the life of the engine. The valve of the high-pressure cylinder is operated directly from the automatic governor, controlling the cut-off from zero to five-eighths. The valve of the low-pressure cylinder is operated from an adjustable eccentric fastened to the back of the automatic governor case, so that any point of cut-off can be obtained from 1-5 to 2-3 stroke.

The crank shaft is of the best forged steel, 12 inches in diameter, with bearings 24 inches long, the offset crank being carefully counterbalanced so that the weight of the reciprocating parts and the centrifugal weight of the connecting rod are balanced as nearly as possible. The exhaust from the high-pressure cylinder is carried through a steam jacketed receiver, which has also an outside jacket to prevent radiation, giving perfectly dry steam slightly superheated for the low-pressure cylinder.



VERTICAL COMPOUND ENGINE FOR ELECTRIC LIGHT AND POWER USE.

The heavy flywheel has a clutch ring firmly bolted to it connecting with the other half of the clutch upon the main line shaft, which is thus driven direct from the engine, upon

which are friction pulleys belting to the dynamos and motors. The steam cylinders are carefully covered with non-conducting material, and then with iron lagging, polished upon its raised surfaces.

The workmanship of these engines is the very best possible, the valve motion is very simple, and the closest economical results are being obtained.

Trolley Overhead Fittings.

The Mansfield strain insulator illustrated in Fig. 1, made by the Ohio Brass Company, Mansfield, Ohio, consists of two steel staples moulded into a special insulating compound. The medium size is 7 inches in length over all and weighs less than three-quarters of a pound and has a breaking strain of 10,000 pounds.

FIG. 1.—STRAIN INSULATOR, PULL-OVER AND TROLLEY CLAMP.

Fig. 1 also shows a single curve pull-over, fitted with a "type W" trolley clamp. The yoke and adjustable cone are made in one malleable casting and insulated from the span wire by a small Mansfield strain insulator. This pull-over was designed to meet the demand for a curve insulator of minimum weight for use on the smaller sized trolley wires.

FIG. 3.—DOUBLE CURVE PULL-OVER.

It is strong enough to support No. 0 B. & S. trolley.

The double curve pull-over, Fig. 3, is similar in design and detail to the single curve pull-over, but has a double yoke and double insulation. The double and single curve hanger bodies are made from the best malleable castings, giving strength with lightness. The insulating pieces are moulded from a special compound selected after the most exhaustive tests. The top and bottom pieces are dovetailed together and also into the hanger body, thus preventing any surface leakage. The iron casting, which is moulded into the insulating cap, is larger than the inside diameter of the collar, which does away with the possibility of the hanger stud pulling through and allowing the trolley wire to drop to the street.

New Book.

FOURIER'S SERIES AND SPHERICAL, CYLINDRICAL AND ELLIPSOIDAL HARMONICS, With Applications to Problems in Mathematical Physics. By William Elwood Byerly, Ph. D. Boston: Ginn & Co. 1893. 287 pages. Price, $3.15.

This little volume treats of Fourier's Series, that is the development of a function of x in terms of sines and cosines of whole multiples of x, and of the corresponding series formed of those higher transcendental functions known as Legendre's Coefficients, or Zonal Harmonics; Laplace's Coefficients, or Spherical Harmonics; Bessel's Functions, or Cylindrical Harmonics; and Lame's Functions, or Ellipsoidal Harmonics. This is a good deal of ground in an abstruse branch of mathematics to be covered in the allotted space, but after a careful examination of the book we are impressed with the highly creditable manner in which this has been done.

The work is called an elementary treatise. Elementary treatises on all subjects have very commonly the fault that in the author's intense desire to make them elementary he leaves out so much of fundamental principle that they are really more difficult to understand than more advanced works. The work under consideration is particularly free from this fault; the introductory chapter is a very satisfactory foundation for the succeeding chapters, and we would call especial attention to the remarks on differential equations, beginning with Article 2. We do not remember to have seen a more clear and concise statement of the principal properties of the kind of differential equations here treated. It may be as well to remark for the benefit of the uninitiated that the branch of mathematics treated in this book has a wide application in all departments of physics. Not only are many problems in the theory of electric and magnetic potential flow of currents, etc., soluble by these methods, but what has a more direct bearing on practical engineering, Fourier's series are the key to the theory of alternating currents, and the improvement of the design of alternating current machinery.

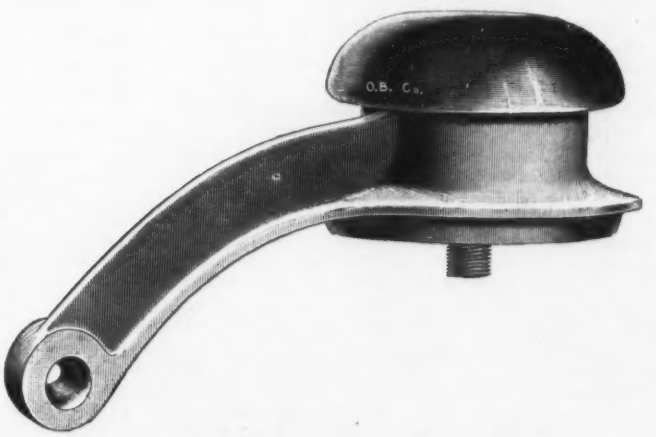


FIG. 2.—SINGLE CURVE PULL-OVER.

The intrinsic difficulty of the subject and not its lack of utility is the reason for its not being more generally known, and the work before us seems to present it in as simple a manner as its nature will admit. There are tables in the back of the book of numerical values of some of the functions employed. They are somewhat incomplete, which is a pity, as complete tables of all and any transcendental functions, excepting logarithms and trigonometrical functions, are scarce in the English language.

Chapter IX. is an interesting historical summary of the subject. The mechanical get up is good and the work as a whole is a creditable production, and to be recommended to students and the higher class of electricians generally.

Financial Intelligence.

The Electrical Stock Market.

New York, Feb. 3, 1894.

THE AMERICAN BELL TELEPHONE COMPANY has petitioned the Massachusetts Legislature for authority to increase its capital stock $30,000,000. The present capital is $20,000,000 and the petition asks for such legislation as will enable the company to increase its capital stock to a total of $50,000,000. According to a statement promulgated by ex-Governor Long, who is the registered counsel of the company at Boston, the increased capital is not asked for in order to enable the company to protect itself against other patents or for the absorption of other companies. The extra capital is asked for because of the growth and development of the Bell Telephone Company's business. The friends of the company say that "the time has come for it to do in the telephone field what the Western Union is doing in the telegraph—that is, to control it." Compared with the Western Union's capitalization of $100,000,000, the new capital of the Bell company, when all it wants to do is considered, is not excessive. The company is going to expand. The long lines are to be perfected and the American Telephone and Telegraph Company (this is the name of the corporation under which the Bell company operates its long-distance lines. It has $5,000,000 capital; the stock is owned by the Bell company, and pays about 5 per cent.) is to extend its system to wherever there is a profitable outlook. An expenditure of from $6,000,000 to $7,000,000 on this score alone is contemplated. Another item of gossip relative to the future of the American Bell Telephone Company has it that the company is preparing, on the expiration of its contract with the Western Union Telegraph Company, to do a telegraph business on its own hook.

GENERAL ELECTRIC was somewhat adversely affected this week by the wide circulation of a report that Prof. Thomson was preparing to form an opposition company, retiring from the General Electric and taking its Lynn works and manufacturing under his patents an arc light, and also what is said to be an incandescent light superior to the Edison lamp. As there have been many reports recently circulated that a dissolution of the General Electric Company was near at hand, this story of a breaking away of the Thomson-Houston interests found ready belief in many quarters. Prof. Thomson himself says: "I do not intend to leave the General Electric Company. I have made all my plans to stay where I am." He sees no reason to change, and attributes the circulation of the story to stock rigging purposes. Moreover, under his contract with the General Electric Company, Prof. Thomson is obliged to offer all his inventions to that company first, and, if he has a superior incandescent lamp, the General Electric Company has first claim to its use.

THE UNITED ELECTRIC SECURITIES COMPANY'S recent reduction of its common stock is now explained to have been done "to enable the company to continue the payment of dividends on the preferred stock, as shrinkage in assets will thereby be allowed to be written off against the common capital instead of against the earnings." This is financiering with a vengeance and of a one-sided character that can hardly be profitable to the holder of the common stock, the General Electric Company. The dividend on the preferred, 3½ per cent., was paid on Feb. 1.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY is preparing to make great strides this spring in extending its business. Next week it will begin to manufacture, under the Sawyer-Mann patents, the stopper lamp glass globes at a cost to the trade much less than that of the present Edison lamp. A review of the company's affairs recently published in the East details some interesting points regarding electric matters. According to the claims made by the Westinghouse people, it is now impossible, by reason of the many new inventions, to control by patent litigation any part of the electric field, except in the domain of arc lighting and of storage batteries, and in the latter nothing in the way of a commercial success has been reached. The trade nowadays is being re-established on a new basis. For instance, the list price for electric equipment of street railway cars, when the business began, was $4,400, but the trade was really only fairly started on a basis of $3,500 per car equipment. To-day a superior equipment, including motor, can be bought for a good deal less than half this price. Incandescent lamps were formerly 85 cents, now they are 35 cents, and they must sell lower. And so in all departments. The point is therefore made that securities taken upon the basis of former prices must suffer a severe shrinkage, and the company that was at first the strongest has had a losing fight all along by reason of the value of its securities on account of the reduction in the value of its manufactures.

WESTERN UNION TELEGRAPH STOCK has been freely sold by insiders this week. Big blocks of stock have been given to prominent commission houses by the people at 195 Broadway, to be disposed of as quietly as possible. The fact has leaked out, however, that close insiders, while trying to so manipulate the stock as to seemingly make the short interest a very large and unwieldy one, have been quietly and steadily feeding the market and a further decline is awaited. It is stated that the Messrs. Gould and Sage are selling their stock on account of advance information they have of poor earnings. On the other hand, bull operators assert that the large borrowing demand really represents the existence of a large short interest and that a smart upward campaigh is on the cards.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
Cleveland General Electric Co	—	85	90
East River Electric Light	100	—	65
Electric Con. & Supply Co., pref	15	15	16
" " " com	15	15	17½
Edison Electric Ill., New York	100	96	99
" " " 1sts	—	104¾	105
Edison Electric Ill., Brooklyn	100	99	101
" " " Boston	100	112	117
" " " Chicago	100	145	150
" " " Philadelphia	100	120	130
Edison Electric Light of Europe	—	—	5
" Bonds	—	80	85
" Ore Milling	—	5	12
Fort Wayne Electric	—	4	8
General Electric Company	100	34¼	34½
" " " deb. 5's	—	72	74
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	—	—	65
Westinghouse Consolidated	50	41	43
" " pref.	50	23½	24½
Western Union Telegraph	—	84	84¼

New Incorporations.

THE CRESCENT ELECTRIC COMPANY, Scranton, Pa., capital stock $50,000, has been formed to supply light, heat and power by electricity to the public. J. J. Williams, T. E. Jones and E. S. Jones are the incorporators.

THE UNION ELECTRIC COMPANY, Portland, Ore., capital stock $5,000, has been formed to contract for the wiring of electrical installations of all kinds. W. W. Brackett, J. L. Lambirth and I. K. Birt, all of Portland, are interested.

THE COLUMBIA CONSTRUCTION COMPANY, Chicago, Ill., capital stock $2,000,000, has been formed to build and equip elevated, street and electric railways, etc. D. H. Louderbach, J. Lewis L. Cochran and Samuel Insull are the promoters.

THE TURNEY ELECTRIC MANUFACTURING COMPANY, Chicago, Ill., capital stock $75,000, has been formed to manufacture, buy, sell, etc., electric and mechanical specialties. The incorporators are E. T. Turney, W. A. Crawders and W. E. Mason.

THE DELAWARE FRONT PASSENGER RAILWAY COMPANY, Philadelphia, Pa., capital stock $24,000, has been formed to construct and operate an electrical railway in Philadelphia. The interested parties are A. R. B. Fox, W. D. Naohys and William Wagner, Jr.

THE MOSHER MANUFACTURING COMPANY, Dallas, Tex., capital stock $50,000, has been formed to manufacture, repair and sell electrical appliances and apparatus, engines, boilers, machinery, etc. J. E. Mosher, T. J. Jones, W.S. Mosher and J. S. Hetherington, all of Dallas, are interested.

THE CHICAGO ELECTORAMA COMPANY, Chicago, Ill., capital stock $25,000, has been formed to manufacture, operate and deal in electrical and scenic machinery and devices and patents and patent rights relating thereto. The promoters are W. P. Sidley, C. H. Hamill and W. J. Louderback.

THE ELECTRICAL POWER COMPANY, Sterling, Kan., capital stock $10,000, has been incorporated to operate an electric light plant and to furnish power. J. H. Recksecker, J. M. Hershberger, Kansas City, Mo.; H. Breckenridge, F. E. Watson, Kansas City, and W. T. Stout, Sterling, Kan., are the organizers.

THE CLEAR LAKE ELECTRIC COMPANY, San Francisco, Cal., capital stock $5,000,000, has been formed to deal in land, water rights, and to build and operate waterworks and electric light and power plants. The promoters are J. Armstrong, C. H. King, J. H. Culver, F. X. Simon and J. B. Treadwell, all of San Francisco

THE UNDERGROUND SEALED CONDUIT RAILROAD COMPANY, San Francisco, Cal., capital stock $500,000, has been formed to deal in patents and devices for propelling street cars by electricity. L. C. Pressley, L. G. Crossby, E. O. Rollins, L. L. Lindsay and C. S. Wheeler, all of San Francisco, are interested parties.

THE PEOPLE'S LIGHT AND POWER COMPANY, Newark, N. J., capital stock $2,000,000, has been formed to construct, buy, sell and operate plants for the production and supplying of electricity, etc. J. K. Corbiere, Caldwell, N. J.; J. L. Munn, J. E. Reynolds, East Orange, N. J.; T. A. Nevin, Orange, and E. B. Gaddis, Newark, N. J., are the promoters.

Special Correspondence.

New York Notes.

Office of The Electrical World,
167-176 Times Building, New York, Feb. 5, 1894.

BROOKLYN, N. Y.—The Kings County Electric Light and Power Company has applied for permission to carry on business in

MR. JAMES F. KELLY has secured the agency of the National Electric Company of Eau Claire, Wis., and has opened an office at room 906, Temple Court.

THE SAFETY INSULATED WIRE AND CABLE COMPANY recently supplied to the Metropolitan Telephone and Telegraph Company, of New York, one of the largest cables ever laid in this country. It is nearly a mile long, is 2¾ inches in diameter and weighs 21½ tons.

New England Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., F . 3, 1894.

THE CITY OF CAMBRIDGE, MASS., is petitioning the legislature for authority to build a conduit for the purpose of burying electric wires, and renting the same.

THE BROCKTON (MASS.) STREET RAILWAY COMPANY will begin as soon as the frost is out of the ground to construct three roads—one to Bridgewater by way of West Bridgewater; another to Elmwood through East Bridgewater, and another to Stoughton.

LYNN, MASS.—The General Electric Company has received an order for 400 railway motors. These, together with the car equipments, are to be made at Lynn, while the generators for the same are to come from Schenectady. It is understood that the order is to be got out by April 1. The General Electric shops in this city were right in the path of the $76,000 fire of this week, and were only saved by the efficient fire shutters.

NOTWITHSTANDING THE SEVERE STORMS which have prevailed for several days, the West End Railway Company has been comparatively free from difficulty in running its regular trips. In fact, the public has not been materially discommoded at all. In Providence, R. I., and some other points in New England there has been some little trouble experienced in operating lines owing to the excessive severity of the storm, but it was quickly removed.

THE UNION RAILROAD COMPANY, of Providence, is to maintain wagons equipped to do service on the wires at all the fires where the trolley is near enough to be dangerous. These wagons are to be provided with every appliance for rapid work in cutting or unstringing wires, and will be manned by a regular force of men, who will sleep at the several stations for the wagons and be just as ready to act as the regular firemen. Horses will be kept on hand for service and everything will be arranged with a view to reaching fires as quickly as possible.

EX-GOVERNOR RUSSELL appeared this week before the Committee on Manufactures of the Massachusetts Legislature in opposition to the bill before that body to enable cities and towns to manufacture gas and electricity for municipal purposes. The Governor drew out from the committee the admission that the bill would hurt the companies, and that it proposed a principle which was not applied to any water company or to any railroad company in the State, and which might cripple seriously any company to which it was applied. The ex-Governor said he was not opposed at all to the principle of municipal ownership, but he objected to the principle of allowing municipalities to come in and destroy the profits of the companies, thus destroying their property.

THE MASSACHUSETTS ELECTRICAL ENGINEERS AND MECHANICS' ASSOCIATION, of Boston, gave its fourth annual ball at Copley Hall, in that city, on the evening of Jan. 29, before a crowded gathering notwithstanding the stormy weather. The electrical decorations and display surpassed all its previous efforts. Current for the incandescent lamps was furnished by the Edison Illuminating Company and for the arc lights by the Boston Electric Light Company. The Telephone Employes' Mutual Benefit Association, of Boston, gave its annual ball on the evening of Jan. 27. It was the most successful in the history of the organization.

Western Notes.

BRANCH OFFICE OF THE ELECTRICAL WORLD
936 Monadnock Building, CHICAGO, Feb. 3, 1894.

THE STAR ELECTRIC LAMP COMPANY, with Mr. A. S. Terry at the helm, is again in the field in earnest. Its new "vapor" lamp has created an unusual amount of interest everywhere, and sales have been very large.

GEORGE C. CARTER & CO. is another firm that finds itself fortunate in the matter of a good business for this season. It is particularly busy in its carbon department, sales of Americar carbons being far above anything expected.

THE CAMPBELL AND ZELL COMPANY has closed in the past ten days the following contracts for the Zell improved water tube safety boilers: Keiffer Brothers, New Orleans, La., 50 h. p.; William Henderson, second order within six months, 317 h. p.; Valentine Blatz Brewing Company, Milwaukee, Wis., 1,164 h. p.; Citizens' Street Railway Company, Indianapolis, Ind., 1,500 h. p.

THE METROPOLITAN ELECTRIC COMPANY is now nicely located in its handsome new headquarters, 188 Fifth avenue. Some remaining touches have to be added to make this place one of the most attractive stores in Chicago. It finds business as brisk as it would like, and with others predicts a bright outlook for the trade. Mr. W. H. McKinlock has just returned from a most successful trip East.

THE BROWN TELEPHONE AND TELEGRAPH COMPANY, of Manhattan Building, is flooded nowadays with inquiries for its perfected magneto telephone, which promises to be one of the most prominent of the candidates for new telephone honors, now that the Bell patents have expired. Its offices in the Manhattan Building are crowded every day with people anxious to secure telephones and advice on their installation.

MR. F. S. TERRY is now giving his attention entirely to the affairs of the Sunbeam Lamp Manufacturing Company, having accepted the office of secretary. He has entirely severed his connection with the Ansonia Electric Company, with which company, or as it was formerly called, the Electrical Supply Company, he had been continuously conected since its organization in 1880, having gone with that company first as its bookkeeper and later on, in the winter of 1884-5, opened the branch in Chicago.

THE ELECTRIC APPLIANCE COMPANY has been keeping a large extra force busy for the past few weeks taking care of the large shipments which are being received and placed in stock in preparation for spring business. The Appliance company is materially increasing its storage and shipping facilities, and when the alterations are completed its arrangements for promptly handling large orders wiill be perfect. Several carloads of wire, cross arms and insulators have been taken care of during the past week and considerably more is still in transit.

CENTRAL ELECTRIC COMPANY.—This company is receiving many inquiries and orders for its "metal-sheathed bushings," a new and valuable product made especially to conform to the requirements of the underwriters' rules. This bushing has many points of superiority over any other kind permitted by the rules, filling every requirement of porcelain tubes, and being much cheaper. The company is veryb usy on all lines and reports business as exceedingly brisk, considering the season and the general trade depression.

THE GREAT WESTERN MANUFACTURING COMPANY.—This company is among those who have nothing to complain of from hard times. During the past thirty days they have sold many important plants, among them being the following: Of 600-light alternating dynamos, with all appurtenances, it has sold one to each name given: Ladd, Illinois; Manselona, Michigan; Reed City, Mich.; Fond du Lac Light and Power Company, Fond du Lac, Wis.; Freeport Electric Light and Power Company, Cripple Creek, Col. Of direct connected dynamos it has sold the following: One 80-kw. compound wound to A. L. Ide & Son, Springfield, Ill. Of direct current constant potential dynamos, one 320-light compound, with plant, to Duncan Brewer & Co., Duluth, Minn.; one 320-light compound, with plant complete, C. P. Brisk & Co., Chicago; one 590-light compound, with plant, Harter Electric Company, Chicago; one 6-kw. direct current motor, Harter Electric Company; one 12-kw. direct current motor, same firm. Also one 50-light arc dynamo and 50 arc lamps, to the Waco Street Railway, Waco, Tex.; one 12-light arc dynamo, with lamps, Cudahy Packing Company, Cudahy, Wis.; one 12-light arc dynamo, with lamps, Iron Mountain, Minn. In addition to this list, it has disposed of an enormous amount of "Clark" wires and cables and general supplies.

English Notes.

(From Our Own Correspondent.)

LONDON, Jan. 17, 1894.

SUGGESTED DEVICES FOR ALTERNATE CURRENT HIGH-PRESSURE CIRCUITS.—At a recent meeting of the Societe Internationale des Electriciens, M. Claude described a device suggested by him for diminishing the danger of touching a wire belonging to a high-pressure alternate-current circuit; a danger which cannot be got rid of by merely adding to the insulation, since the danger is mostly due to the capacity of the wires with regard to earth. M. Claude's remedy is to actually connect each lead to earth through a low ohmic resistance choking coil, the mains then behaving as if they had next to no capacity. The device is of considerable scientific interest, but it seems likely that these choking coils will prove expensive, and as they are only efficacious so long as the mains are not connected to earth through a leak having a little self-induction, the insulation would in addition have to be very good, so that there would be no corresponding saving in this direction. In this conection, I may mention that the inquest on the unfortunate man who was killed in September last in one of the transformer sub-stations belonging to the London Electric Supply Corporation was concluded yesterday, the inquest having been adjourned to enable the man who was injured at the same time to attend and give evidence. The accident occurred through an employe being sent by inadvertence to clean a "live" switch gear, the man who was sent being merely injured, whilst the man who sent him and came to his rescue was killed. The verdict of the jury was as follows: "We are of opinion that had the man been provided with gloves, the danger might have been averted. We also think that the rules and regulations of the station should have been printed, and that the second man should have been more competent before undertaking the work."

THE DOUGLAS-SAXEY ELECTRIC TRAMWAY.—An electric tramway seven miles long, part of which came into operation last summer, is in course of completion between Douglas and Saxey in the Isle of Man. The line runs along a very pretty coast, and has necessitated the construction of a large number of bridges, embankments and sea walls. The only feature of electrical interest is that this line is yet another example of the preference felt in this country for taking the current off an overhead wire by means of a pair of underrunning metal bars.

News of the Week.

Electric Light and Power.

SOUTHERN PINES, N. C.—The new Piney Woods Hotel is to have an electric light plant.

LOCKPORT, N. Y.—The Council is discussing the matter of a municipal electric lighting plant.

ADRIAN, MICH.—Adrian residents are agitating for the establishment of an electric lighting plant.

NEWVILLE, PA.—The incoming Council will likely consider the matter of an electric lighting plant for the borough.

BRUNSWICK, MO.—The city has voted for the issuance of $10,000 in bonds for the purpose of a municipal electric light plant.

GLENCOE, MINN.—Residents of Glencoe will soon vote at a special meeting in the matter of electric lights and waterworks.

DAWSON, GA.—A company with a capital stock of $10,000 is being organized with the purpose of erecting an electric light plant.

Brooklyn, and the matter has been referred to the Committee on Lamps and Gas. Mirabeau L. Towns is president of the company.

ONTONAGON, MICH.—The matter of electric lighting for the streets of Ontonagon will be discussed at the next meeting of the Council.

WILMINGTON, WINDHAM COUNTY, VT.—Joseph Courtemanche offers to put in a dynamo, provided 125 subscribers can be secured.

SEARCY, ARK.—W. G. Brown and J. T. Pullen, of Little Rock, have been granted a franchise for the erection of an electric lighting plant.

WYNNE, ARK.—An electric lighting plant is to be erected. The Kennedy & Morelock Stave Company can be addressed for information.

LINDENHURST, SUFFOLK COUNTY, L. I., N. Y.—Residents of Lindenhurst are contemplating the establishment of an electric lighting plant.

YORK, PA.—The matter of the proposed electric lighting plant for York was again brought up at a meeting of the Council, but no definite action was taken.

MINNEAPOLIS, MINN.—City Engineer F. W. Cappelen will present to Council at the first regular meeting in February plans for a municipal lighting plant.

GRAND RAPIDS, MICH.—The Council contemplates an election to vote in the matter of a bond issue of $150,000 to purchase or build an electric lighting plant.

GRAFTON, WIS.—An electric light plant is to be established at one of the water powers at Grafton to light the village, Cedarburg and other villages in the vicinity.

CHICAGO, ILL.—The West Side Improvement Club is seeking to secure electric lights for Douglas Park. A committee has been appointed to wait on the Park Board.

BENWOOD, W. VA.—Benwood business men are soliciting subscriptions toward the $35,000 capital needed for the establishment of the proposed electric lighting plant.

BATTLE CREEK, MICH.—The Battle Creek Electric Company, of which W. A. Foote is manager, has decided to put in a machine to furnish electric power to factories, etc.

SPARTA, WIS.—The city is contemplating the purchase of the plant of the Thayer Electric Light Company and using it for city purposes as well as for individual lighting.

SPRINGVILLE, ERIE COUNTY, N. Y.—The trustees of Springville have given the water company there the privilege of putting up poles and stringing wires for electric lights.

ROCHESTER, N. H.—A resolution was adopted authorizing the committee on electric lights to ascertain if the city could save money by purchasing an electric lighting plant.

BRISTOL, PA.—Residents are discussing the matter of arc lights and a committee has been appointed to confer with the electric light company relative to the price per light.

KANSAS CITY, KAN.—The Consolidated Electric Light Company will soon commence extensive improvements on its electric lighting plant. Benjamin Friedburg is the president.

CEDAR RAPIDS, IOWA.—Proposals are called for to Feb. 12 for lighting the streets by electricity, gas or naphtha, as per details to be had of J. L. Hardwick, chairman of the Board of Public Works.

WHITEHALL, N. Y.—McLachlin & Son, owners of the Whitehall electric light plant, recently burned, state that they have put men to work rebuilding and will again furnish light as soon as possible.

INDIANAPOLIS, IND.—The County Commissioners met and formally rejected all bids for lighting in the court house and county jail. Others will likely be called for under new specifications.

NEW ORLEANS, LA.—Bids will be received by J. B. Fischer, chairman of the Young Men's Gymnasium Club, for the erection of an electric light plant and installation of electric lights and fans in the building.

BALTIMORE, MD.—Edward D. Preston, of Clay street, has received the contract for rebuilding the works of the Brush Electric Light Company, recently burned. The figure is about $40,000. Henry Brauns is architect.

MEMPHIS, TENN.—The New Lyceum Theatre Company wants plans for a fireproof steel building for a theatre. A steam-heating plant, dynamo and furniture are to be included in the cost, which is $100,000. S. D. Kyle is secretary.

LAWRENCE, MASS.—The Board of Aldermen have instructed Mayor Rutter to support the bill now pending in the legislature authorizing cities and towns to construct and maintain conduits for telephone and electric light wires.

EASTON, MD.—It is proposed to introduce a bill into the present Legislature authorizing a bond issue of $50,000 for the purchase of the present waterworks and electric lighting plant or for the creation of new plants, if same cannot be bought at a fair price.

EASTON, PA.—Sealed proposals will be received to 5 p. m. Feb. 13th by L. M. Fine, City Clerk, for about 6 miles of hard-drawn insulated wire, to be used for Gamewell Fire Alarm System, as per samples furnished, on application to Thos. P. Ricker, chief of the fire department.

BATAVIA, N. Y.—The bid of the Fort Wayne Electric Company for the proposed electric light plant of Batavia has been accepted at $12,776.90. The system is similar to that operated in Batavia at present, and which gave satisfaction when operated by the Consolidated company.

EVERETT, MASS.—An order was introduced at the meeting of the Board of Aldermen that the Mayor file a petition with the legislature for permission to hold a special election to see if the citizens will accept the authority granted by the statutes to erect and maintain an electric light and gas plant.

GREAT BARRINGTON, MASS.—The new cotton company expects to have its own electric lighting plant for lighting its mills at Riverdale, near here. It is also reported that the Great Barrington Electric Light Company wishes to have the Riverdale corporation furnish power to light the streets all night.

PALMYRA, N. Y.—The Canandaigua Electric Light and Railroad Company has built an electric light plant at Littleville, which cost $50,000, and they state that as soon as the plant is completed they will light Palmyra, Manchester, Shortsville and Canandaigua. It is now believed that Palmyra will have electric lights in the spring.

HAMILTON, OHIO.—The special committee appointed by the Council to superintend the construction of the new euectric lighting plant consists of Messrs. Helvey, Miller, Wirtz and Rice. They have met Engineer Charles Cornell and looked over plans and specifications. The engineer has been instructed to have those in shape for the next meeting of the Council.

MOLINE, ILL.—The city has owned and run its own electric light plant for a number of years, but found that it was a very poor investment and that their lights were costing them much more per year than they would if they made a contract with the local company. The electric light plant has therefore been sold to the Rock Island People's Power Company and a two years' contract made with them for light.

ANNAPOLIS, MD.—Proposals will be received until noon of the 12th of February for lighting the streets of Annapolis with gas or electricity for three or five years. Proposals will also be received for the construction of an electric lighting plant with sufficient capacity to light the city and for the necessary construction of lines, lamps, etc. Bids will be received together or separately. At present the city is using 43 arc lights of 2,000 c. p. and 85 incandescents of 16, 25 and 50 c. p. Thomas Himelheber is clerk.

LE ROY, N. Y.—Charles F. Prentice, president of the Le Roy Salt Company, has for the past year been engaged in the construction of an electric transmission plant to utilize the power of Oatka River, one mile north of the village. A stone power house 40x70 has been built of material blasted out of the wheel pit. One 21-inch McCormick cylinder gate turbine has already been set. It has a 4-foot feed pipe and develops 156 h. p. with a 35-foot head. Another turbine of 220 h. p. will be added, with an electrical equipment, consisting of a power generator of 150 h. p. and 750-light incandescent machine. A steam plant will supplement this and possibly a trolley road for the use of the stone quarry.

ROCK ISLAND, ILL.—The People's Power Company, which purchased from S. M. Hamill, general manager of the Brush electric companies, Cleveland, Ohio, the gas and electric companies held in his name, and the Moline, Ill., companies, is erecting a large new electric light station on the water power located between Moline and Rock Island. The electric light stations in Rock Island and Moline will be abandoned and all their good apparatus removed to

the new station. A large amount of new electric lighting apparatus has been recently purchased from the Brush company, and plans have also been laid for the distribution of the power the two cities will need. The new People's Power Company has a capital stock of $300,000. C. H. Deere is president, S. S. Davis, secretary; C. O. Nason, treasurer.

The Electric Railway.

GREENSBORO, N. C.—The City Council has granted a franchise for a street railway. C. H. Harman is manager.

MEDFORD, MASS.—The West End Railway Company will soon begin work on its proposed stable and car house in Medford, off Salem street.

MEMPHIS, TENN.—It is reported that the East End street railway will change its motive power to electricity. W. M. Smeed is president.

CAPE CHARLES, VA.—The Baltimore "News" is authority for a statement that an electric line is contemplated between Cape Charles and Parsonville.

LITITZ, PA.—John R. Bricker, of Lititz, is receiving subscriptions for bonds of the proposed electric railway between Lititz, Lancaster and Manheim.

FITCHBURG, MASS.—The selectmen have decided to grant the franchise for the West street line to the Fitchburg and Leominster Railway Company.

CALAIS, ME.—Mr. A. F. Gerald, of Fairfield, has been in Calais for the past few days in the interest of the electric railway which he proposes to build there.

McKEESPORT, PA.—The McKeesport and Wilmerding Railway Company is considering the erection of a light station and the placing of arc lights along its route.

LYNN, MASS.—It is stated that the Boston, Revere Beach and Lynn Railroad will start the work of equipping its line electrically next spring, but the method is not yet decided.

MYERSVILLE, MD.—The following are the directors of the proposed electric road from Myersville to Middletown: G. W. Wathtel, D. V. Harp, C. F. Flook and E. J. Smith.

HAYDENVILLE, MASS.—The electric road here is a certainty, and it is stated that the matter of an electric lighting plant, to be run in connection therewith, is also under consideration.

NORTHAMPTON, MASS.—The Northampton Street Railway Company will likely be granted permission to extend to Williamsburg and Easthampton. President Olmstead will give details.

NEWBURGH, N. Y.—The Newburgh Street Railway will be sold at public auction on Feb. 6 by James H. Moran as assignee in the suit of the Farmers' Loan and Trust Company against the railway company.

BALTIMORE, MD.—The Baltimore County Commissioners have granted a franchise to the Pikesville, Reisterstown and Emory Grove Railway Company, and the work of construction will begin within six months.

BRADDOCK, PA.—The incorporators of the proposed Braddock and Homestead Electric Street Railway Company, to build one and a half miles of road, are C. Jutte, F. K. Morse, C. M. Buchanan and George W. Theiss.

ELIZABETH, N. J.—A franchise will likely be granted by the council on Feb. 1 to the Suburban Electric Railway Company to run cars through Orchard street to connect with the Morris avenue and Cranford, Westfield and Plainfield lines.

DETROIT, MICH.—The Detroit and Howell Plank Road Company will build an electric railway to extend ten miles northwest of Detroit. M. M. Willmarth, C. E., 310 Hammond Building, and Frank D. Clark, 408 Trumbull avenue, Detroit, Mich., are interested.

READING, PA.—A special to the Philadelphia "Public Ledger" states that the engineering corps has laid out a route for the extension of the lines of the Reading and Southern Electric road from Mohnsville to Adamstown, in Lancaster county. About $25,000 of the $50,000 needed has been subscribed, and work will be begun in the spring.

WILMINGTON, DEL.—The Wilmington "Star" is authority for the statement that the Gordon Heights Railway will be built and finished to the river front in the spring or early summer. It will connect with the Wilmington Steamboat Company's line at their wharf at Gordon Heights station.

ELMIRA, N. Y.—The petition of the West Side Railway Company for leave to increase its capital stock from $100,000 to $300,000 has been granted by the State Railroad Board. President Tompkins of the company states that the step was necessary because of intended extensions of the road in the spring to Horseheads.

SPRINGFIELD, MASS.—The Wyman-Lea Electric Railway Company has organized to build in the spring a railway to connect Springfield and Holyoke. This is intended to be the first move toward building a competing line with the Boston and Albany Railway to connect Boston with the Connecticut Valley. The capital is $300,000.

WASHINGTON, D. C.—The Washington and Georgetown Terminal Railway Company is before the Commissioners with a petition to build and operate a belt line, and such permission will likely be granted. Amongst those interested are E. Kurtz Johnston, William A. Wimsatt, J. B. Rank, E. Southard Parker and Andrew B. Duvall.

BRADDOCK, PA.—The Braddock Electric Street Railway Company will likely rebuild its old line. A. L. Taylor is president and C. F. Ellis is secretary. The officials have held a meeting with the Supervisors and filed a bond of $5,000 that they will have the road built and in operation by July 1 next. It will be remembered that the road was abandoned some two years ago and the tracks covered up. The supposition is that it will connect with the Duquesne Traction Company.

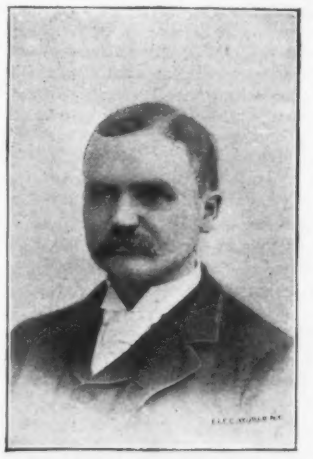
NEWPORT, R. I.—Now that a charter has been granted for the proposed electric railway to run a line of cars from One Mile Corner to Stone Bridge, the only remaining requirement is the permission of the authorities of Middletown and Portsmouth to lay tracks. Senator E. A. Brown, of Middletown; E. F. Dyer, of Portsmouth; A. C. Titus, of Newport, president of the Newport Street Railway Company, and Lorenzo Tallman, of Newport, are interested. It is expected that work will be begun in the early spring.

ANDOVER, MASS.—The hearing before the Selectmen of the town of the South Side Street Railway Company for permission for location on its route from Lawrence to Lowell was held and no objection was made. Two locations were asked for, one on the river road, and the other on the Tewksbury road and private lands. The hearing in Tewksbury is to be held Feb. 21. The major part of the route lies in the two towns; the terminals only being in the cities. The company desires that two years be given in which to complete the line.

BATAVIA, N. Y.—Capt. Lina Beecher is the projector of an electric road connecting Batavia with Oak Orchard, on Lake Ontario, and preliminary work is well under way. It is proposed to use the Beecher single rail, elevated 12 feet above the surface of the highway on steel supports. The motive power will be storage batteries, and both freight and passengers will be handled. The estimated cost of construction is $10,000 per mile and the Oak-Orchard-on-the-Lake company has taken $25,000 worth of stock. The road will probably take in Albion and Waterford, where unlimited water power is available.

Personal Notes.

MR. JOHN WARING, the inventor of the Novak lamp, is a type of the modern inventor who, equipped with a thorough scientific knowledge, applies scientific methods to invention. Mr. Waring was born at Darlington, Wis., in 1862, and graduated from Cornell University as a mechanical engineer in 1884, although a portion of his senior year was devoted to electrical work in the physical laboratory under Prof. Anthony. In 1886 he became connected with the Mather Electric Company and had charge of their laboratory. His duties were connected with testing and special work, and among other work he perfected resistance boxes for fine measurements and designed a copper coil for the same purpose to be used for directly reading temperatures, which has been supplied to a number of the best boxes in this country. He also worked on ammeters, voltmeters and galvanometers, developing the present type of magnetic vane instruments from a French model. In 1890 Mr. Waring became the electrician of the Perkins Electric Lamp Company, with whom he remained until its factory closed on Dec. 1, 1893. Mr. Waring's recent connection with the Novak lamp is too familiar to require comment.



Miscellaneous Notes.

A COMMON CARRIER.—The Federal Court of Appeals at Kansas City, Mo., through Judge Smith, has decided that a telegraph company is as much a common carrier as a railroad company, and, therefore, when it does business in more than one State comes under the interstate commerce laws.

THE CHICAGO ELECTRICAL ASSOCIATION at its last meeting listened to a lecture by Mr. W. Clyde Jones on "A History of the Telephone." On Feb. 13 Mr. A. M. Walter will read a paper on "The Student Course at Lynn," the discussion of which will be opened by Mr. F. S. Hickok, of the Western Electric Company.

SANTA FE, N. M.—A 20-year franchise has been granted to I. Sparks, the manager and secretary of the Sante Fe Electric Company, for the operation and erection of a local telephone exchange in the city of Santa Fe. The poles and lines are now erected, and

the exchange will be put into operation as soon as practicable. A $2 rate will prevail. Sixty-five subscribers have entered into contracts for one year from date of the opening of the central office.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION has extended an invitation to electric railways to be represented at the seventeenth convention of this Association, to be held in Washington, D. C., Feb. 27, 28 and March 1, 1894. They are informed that some of the topics for discussion will be of particular interest to electric railway companies, such, for instance, as "Storage Batteries," and that the electrolytical effects of return currents will be treated of in a paper entitled "The Importance of Complete Metallic Circuits for Electric Railways," which will merit wide attention from railway interests, and will be thoroughly discussed.

CITIZENS BURIED THE RAILS.—At Auburn, Me., there has been a bitter fight between citizens and the local street railway company, which culminated recently by the citizens seizing a snowplow in operation and immedately selling it at auction. They then covered up the tracks with snow and ordering out the city fire engine turned the hose on the banked snow, which soon became frozen into a compact mass. The city officials were forced to assist in these measures by an indignation meeting. In the neighboring city of Lewiston, the tracks were also covered and policemen ordered to guard against their being cleared, notwithstanding that an injunction had been issued against any interference with the street railway company's property.

PENNOCK IN NEW PASTURES.—The Atlanta "Constitution" of Jan. 14 contains an advertisement of the Pennock Battery Electric Light and Improvement Company, soliciting subscriptions to the stock of that concern. We warn the Southern public against placing reliance in the absurd claims for this system, and advise any intending investor to write to Peoria, Ill., and Bridgeport, Conn., for information in regard to Pennock himself. It would be interesting to know the professional standing of the following sponsors of the system, whose recommendations are used to bolster up its claims: William R. Beebe, M.D., Bridgeport, Conn.; F. G. Hatch, "electrician," Boston; Charles R. Thomas, "Edison Elec. Ill. Co.," Boston; John H. Wesler, "electrical expert," Bridgeport, Conn., and R. H. Gribben, "electrician," Boston.

THE NETHERLAND SOCIETY FOR THE PROMOTION OF INDUSTRY asks for papers containing an indication of the means to obtain energy through windmills, to accumulate this energy electrically, to transmit it or to make it transportable; and desires more particularly an answer to the following questions: 1. What is the average energy a common windmill is able to produce, per day of 24 hours, in combination with an electric accumulator; what would be the installation most suitable to this effect and what would be the cost of one-horse power hour? 2. Is it possible from an economical point of view to apply the new aerial motors on an extensive scale for the accumulation and the utilization of this energy? If so, what mechanical appliances would be required for this purpose? The project of a supposed application of the system, by which a factory is provided with light and power, is wanted as an illustration. The drawings belonging to the answers must be made on white paper (no blue prints) on a scale of ¼. The prize offered is the gold medal of the society and a reward of £30 ($140.) Answers must be sent before July 1, 1894, with the author's name in a closed envelope, to the general secretary of the society, F. W. Van Eeden, at Haarlem, Holland.

Trade and Industrial Notes

THE ELLIOTT-LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, is running its factory overtime in order to fill its orders.

THE MILLER CONSTRUCTION COMPANY, of Pittsburg, reports business first-class, having sufficient orders ahead to keep it busy for some time.

PURITY OIL FILTER COMPANY, 901 Water street, Pittsburg, reports business excellent; orders for January were largely in excess of any month last year..

J. L. HAYS & CO., 830 Liberty street, Pittsburg, report business for this year thus far has been very good. The company is running full time and has all it can do.

THE AUTOMATIC SWITCH COMPANY, of Baltimore, reports business improving very nicely. Collections, however, are yet a little slow, but improvement is also noticeable in this direction.

WILLIAM J. TROTT has resigned his position as electrical engineer of Furniture City Electric Company to accept the management of the Wolverine Electric Light Company, of Holland, Mich.

WALLACE & SONS, Ansonia, Conn., have made a proposition to their creditors to pay them 60 per cent. of the face value of their claims, or the firm will place the whole business in the hands of three trustees, to be run for the benefit of the creditors.

THE WENSTROM ELECTRIC COMPANY, of Baltimore, is about to place on the market a new arc lighting apparatus which is said to be an improvement on those at present in use. Mr. J. P. Smith, of this company, reports business prospects very encouraging.

FRANK W. STEWART, 1,208 Green street, Philadelphia, now has the agency for the Novak lamp for the territory formerly covered by Messrs. O. D. Pierce & Co. He was employed by Messrs. Pierce & Co. for nearly two years as salesman and is well acquainted with the trade.

JENKINS BROTHERS, 71 John street, New York, have issued a new catalogue and price list of their celebrated valves and packing. All of the various valves, packing and steam fittings manufactured or handled by this firm are illustrated and directions given how to use their standard packing.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J,. has isued a second edition of its instructive pamphlet on graphite as a lubricant. Many opinions of men competent in various lines are given as to value of graphite as a lubricant, including an elaborate test by Prof. Thurston.

THE WASHINGTON CARBON COMPANY, of Pittsburg, reports business very much improved and the prospects for a good year as very promising. This company shortly will place on the market a new special carbon for arc lamps, which, it is claimed, will be different and superior to anything yet introduced.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., has designed and built the new iron coal sheds of the Grosvenor-Dale Company, Grosvenor-Dale, Conn., which are so arranged that the coal can be unloaded direct from the cars into the pockets without handling. The Grosvenor-Dale Company expect to save a large amount of money each year by lessening the expense of handling their coal the second time.

THE RUSSELL ELECTRIC MANUFACTURING COMPANY, 212 Eddy street, Providence, R. I., has published a number of photographic reproductions showing the operation and giving views of their well-known mast arms of which, we learn, there are now in daily use more than 100,000 lineal feet. The views are printed on heavy cardboard and the different sheets held together by a single eyelet fastener, which is quite a convenient innovation.

THE SPERRY SINGLE-MOTOR SYSTEM and Sperry electric brake have been selected by the People's Traction Company to go on its system in Philadelphia, Pa. It made this selection after the most thorough investigation, the electric brake especially being a pleasing feature to them. The electric brake simply stops the car with the same kind of power which is used to start it, and the adoption of such a device is claimed as a great step in advance.

CHARLES A. SCHIEREN & CO., 45 Ferry street, New York, have their Dixie Tannery, Bristol, Tenn., about ready for business and are beginning the operation of tanning there. The best quality of bark is obtained there, and they intend to manufacture the best quality of leather suitable for leather belting purposes, only tanning leather for the best belting for their own use. They report encouragement in the volume of business for the month of January, and think the outlook brighter.

THE VIADUCT MANUFACTURING COMPANY, of Baltimore, reports that a great improvement has taken place in its business during the past three weeks, and it has booked orders for thousands of telephones, magnets, call bells, switchboards and other apparatus pertaining thereto. The experience of this company in this particular line has been very extensive, and the quality of goods turned out by it is well known, and anything that is not satisfactory will be made so.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, Ill., has just taken the general sales agency for the P. & B. specialties, which include paint, armature varnish, electrical compounds, tape and Chatterton's compound. A large stock will be carried at its store and warerooms, 186-188 Fifth avenue, and prices will be made the same as from the factory. This is an important arrangement, and the Metropolitan Electric Company is to be congratulated upon securing this agency.

C. C. PECK, Rochester, N. Y., has received the contract for the boilers to supply the Detroit city electric light plant, the well-known Peck boiler having been selected after strong competition. The order is for seven 300-h. p. boilers to carry 165 pounds of steam, working pressure. Each boiler is required to evaporate 9,000 pounds per hour of feed water at 100 degrees Faht. into steam at 165 pounds gauge pressure, and to evaporate 10 pounds of water from and at 212 degrees per pound of combustible in Hocking Valley coal. The duty is that of supplying triple expansion vertical marine engines used in running dynamos.

WILEY & PHELPS, Monadnock Building, Chicago, have received favorable reports from Europe in regard to the Laval steam turbine, where recently 205 have been sold in competition with other motors for electric lighting. Great success has been met with in their introduction on account of the small weight and space occupied and the admirable steadiness of light, which results from the high speed and ingenious governor used. Up to date no wear has been detected in any of the machines in use. At the recent exhibition in Batavia the Laval steam turbine received an "honorable reward," the highest distinction granted.

THE NEWTON ELECTRIC COMPANY, of 39 and 41 Cortlandt street, New York City, is now ready to introduce very extensively its lighting appliances. It manufactures a line of sockets, cut-outs, fixture and arm switches, etc., which are all simple, mechanical and sold at reasonable prices. Thirty thousand of its sockets have already been sold and are working very satisfactorily. Its factory is on 17th street and has a capacity of 300,000 sockets

per annum, beside a proportionate number of their other special appliances. They are the only manufacturers of the standard socket in this city. W. J. Newton is the manager.

PARTRICK & CARTER CO., 125 South 2d street and 131 Gothic street, Philadelphia, Pa., has issued the 1894 edition of its well-known catalogue of house goods and general electrical supplies—a book that is found almost indispensable to dealers in electrical goods. The 1894 edition is bound in cardboard covers and contains 136 7¾x10½ inch pages, with some hundreds of illustrations. Eleven pages are devoted to a list of hotels using the Partrick & Carter patent needle annunciator, a glance at which shows that a prospective purchaser in any part of the United States or Canada will have but few miles to travel in order to inspect the working of this system. A commendable feature of this catalogue is the concise explanatory notes that accompany most of the illustrations, which contain many hints as to the selection of apparatus and material for particular duty or service and point out special features.

THE CARPENTER ENAMEL RHEOSTAT COMPANY, Bridgeport, Conn., will immediately put upon the market a full line of electrically heated appliances, such as soldering irons, flat irons and glue pots, various kinds of electrically heated tools, as well as electric cooking utensils, such as chafing dishes, coffee pots, ovens, broilers, etc. The rheostats of this company are now in almost universal use by manufacturers of electrical generators and motors, and by electric contractors. Their theatre dimmers and field rheostats have such marked advantages as regards space and safety from fire as to have really no competition, and the progressive policy of this company in continuing to make reductions in price, notwithstanding this is in marked contrast with usual methods of charging high prices because of the protection of fundamental patents. The following agencies of the company have recently been established: Walker & Kepler, Philadelphia; Sargent & Lundy, Chicago; Owen Ford, St. Louis; William Oswald, New Orleans.

THE INTERIOR CONDUIT AND INSULATION COMPANY has issued its annual report and statement, which are highly satisfactory in view of the business depression during eight months of the period covered. The report states that the license agreements referred to in last year's report as likely to be shortly consummated, and to yield substantial royalties to the company from the manufacture and sale of new generators and railway motors, have not been consummated, mainly on account of the financial panic of the past summer. The Board of Directors states its determination that the company's interests would be best conserved by awaiting a more opportune time wherein to conclude such transactions, particularly in view of the fact that in so far from suffering any deterioration by the lapse of time, the inventions involved are being improved upon and supplemented by others of great value, all going to make up a highly organized system of railway equipment, with which the directors feel they can deal to much greater advantage than with the segregated parts hitherto constituting the subject matter of their license negotiations.

THE OHIO BRASS COMPANY, Mansfield, Ohio.—The officers of this company are Mr. E. T. Cooke, president, and Mr. F. B. Black, secretary and manager, both well known as active business men of Mansfield, with an extensive experience in the manufacturing business. Mr. C. K. King, who was lately connected with the Ansonia Electric Company, of Chicago, and is well known among Western street railway men, has been engaged to look after the interests of the electrical department and act in the capacity of special salesman. This company is not a novice in the manufacture of street railway supplies, as it has been engaged in this line of work for several years past, a large Western supply house having taken its entire output. Its manufacturing plant consists of a machine shop and foundry equipped with machines of the most improved design, and a complete laboratory for testing purposes, fitted with a Riehle Brothers testing machine, Queen & Co. testing sets and the electrical meters necessary to make exhaustive measurements on the different articles which this company puts out to the trade. The company intends to send out a comprehensive and reliable record of tests made on the various articles manufactured by it, which will include the breaking strains and insulator resistances of each article, so that the engineer in charge of the construction of a road will have reliable data to figure on. An illustrated catalogue of a complete line of material necessary for the construction and maintenance of electric street railways will be ready for distribution about Feb. 15, which every street railroad man will find of interest to him.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

U. S. PATENTS ISSUED JAN. 23, 1894.

(In charge of W. A. Rosenbaum, 177 Times Building, New York.)

513,097. PHONOGRAPH; T. A. Edison, Llewellyn Park, N. J. Application filed Dec. 3, 1890. This comprises a centrifugal governor connected with a motor operating a phonograph, a spring contact in the motor circuit normally resting on the movable part of the governor, a stop in the path of the contact, and another connection with the governor completing the motor circuit.

513,109. ELECTRIC RADIATOR; W. D. Hough and E. Z. Burns, Niagara Falls, N. Y. Application filed Jan. 9, 1893. This comprises two sections, the metallic parts of which are insulated from one another, pipes in connection with but insulated from the sections, and electrical connections from the sections.

513,111. ELECTRIC ARC LAMP; W. Jandus, Cleveland, Ohio. Application filed Oct. 22, 1892. In an arc lamp, a carbon-holding tube formed with a contracted socket portion having longitudinal slits closed at both ends.

513,112. GAS AND ELECTRIC COUPLING; W. J. Kelly, Boston, Mass. Application filed Sept. 19, 1893. This comprises two hollow members, one having arms secured to the outside thereof, a collar carried by and movable on the outside of the other member and engaging the arms of the other member, and means to lock the collar and arms together.

513,113. ELECTRIC LIGHT FIXTURE FOR MUSIC STANDS; W. J. Kelly, Boston, Mass. Application filed Sept. 19, 1893. A fixture for a music stand consisting of a hollow body containing an incandescent lamp and provided with a longitudinal slit to emit the light.

513,122. ELECTRIC SAFETY DEVICE FOR ELEVATORS; R. W. Magrane, Brooklyn, N. Y. Application filed March 17, 1892. A device adapted to engage a stop on the valve rope when the door is open, an electric circuit and a make and break contact for the circuit controlled by the opening and closing of the door.

513,126. RHEOSTAT; W. Meredith, Aurora, Ill. Application filed April 20, 1892. The combination with a series of perforated plates of a bolt passing through the perforations and insulated from the plates, and terminals whereby the solid mass of plates is brought into circuit and the free ends are left exposed to reduce the heat of the mass.

513,134. ELECTRIC ELEVATOR; N. P. Otis, Yonkers, N. Y. Application filed June 25, 1890. The combination with the elevating engine of a current controller consisting of a switch and a disc, two springs connected on opposite sides with the centre of the disc and tending to restore it to a mid-position, and means for operating the switch.

513,181. MICROPHONE; A. Groper, Dusseldorf, Germany. Application filed Jan. 14, 1893. A transmitter having a mica diaphragm and a carbon diaphragm arranged with an air space between them, the mica diaphragm adapted to receive and transmit sound waves to the carbon diaphragm, and a number of carbon balls in contact with the carbon diaphragm and subjected to varying pressures, and an electric current passing through them.

513,213. ELECTRIC MOTOR-CONTROLLING DEVICE; J. E. Stanton, Boston, Mass. Application filed June 19, 1893. The combination of fixed plates connecting strips insulated from each other, a movable guide piece of non-conducting material provided with spring contact pieces adapted to engage with the plates and connections to form part of a circuit through a motor and generator.

513,219. ELECTRIC BELL; C. Turnbull, Jr., North Shields, England. Application filed July 24, 1893. An electric bell having an extension upon its vibrating arm, and a make and break connection between the extension and the hammer arm.

513,220. ELECTRIC BELL; C. Turnbull, Jr., North Shields, England. Application filed Nov. 11, 1893. An electric bell having a fixed extension upon its vibrating armature, the outer point of which extension is pivoted to an intermediate point on the hammer bar, and a make and break point of circuit between the inner end of the extension and a point to which the circuit wire is connected.

513,245. SECONDARY BATTERY; E. and L. Paget, New York, N. Y. Application filed Feb. 9, 1893. In a secondary battery, treating the electrodes in a solution of nitrate of magnesium.

513,250. ELECTRIC LIGHT CUT-OFF; J. B. Stewart, Haverstraw, N. Y. Application filed June 21, 1893. This comprises a single magnet and armature, a rocking arm mounted on the magnet, the arm being provided with a conducting and a non-conducting bar and having electric light terminals, and a single projection on the arm engaging the armature lever by which it is operated.

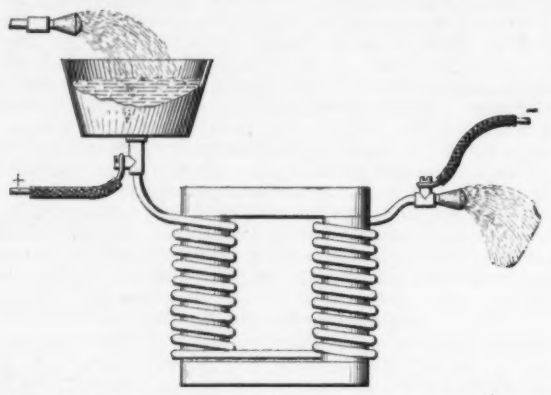
513,251. ELECTRO-MECHANICAL GONG; N. H. Suren, New York, N. Y. Application filed Oct. 11, 1893. The combination with a striking arm of two springs for alternately moving it in opposite directions, the springs being joined so as to be wound simultaneously.

513,264. ELECTRIC METERS; J. C. Henry, New York, N. Y. Application filed Dec. 24, 1891. This comprises an irregularly shaped member moved by a controlling mechanism adapted to correct irregularities therein and to transmit regular movements in opposite directions to connected registers or indicators.

513,294. ELECTRICAL APPARATUS FOR FIRING SUBMA-

RINE MINES; G. Bertolini, Venice, Italy. Application filed April 6, 1892. The combination of discs supported on a stand and having electrical conductors with contact points, a shaft rotating on the stand, a vertical contact piece carried by the shaft, a telescope trunnioned on the shaft, contacts affixed to the telescope, and a device adapted to be inserted between the contacts.

513,300. ELECTRIC GAS LIGHTER; W. L. Brown, San Francisco, Cal. Application filed June 22, 1893. This comprises a movable electrode, a rotatable cam having eccentric and concentric passages communicating at their ends and adapted to en-



No. 513,422.—MEANS FOR COOLING ELECTRIC CONDUCTORS.

gage the movable electrode to move it when the cam is turned in one direction, and to allow it to remain stationary when it is turned in the other direction.

513,305. TELEPHONE TRANSMITTER; F. R. Colvin, New York, N. Y. Application filed Oct. 10, 1893. A transmitter provided with a diaphragm carrying a cell containing a granular conductor and fixed electrodes relatively non-vibratory in contact with the granular conductor.

513,345. ELECTRIC CALL BELL FOR PNEUMATIC TUBES; L. Strouse, Baltimore, Md. Application filed April 6, 1893. This comprehends the use of an electromagnetic call bell, which is operated when a call is to be made by a puff of air through a tube.

513,347. MAGNETO-ELECTRIC MACHINE; H. H. Taylor, Los Angeles, Cal. Application filed March 15, 1893. An electromagnetic machine provided with movable auxiliary pole pieces arranged respectively at each side of the permanent pole pieces of the machine and adapted and arranged to be moved toward and away from, and to fit close to the periphery of the armature.

513,349. MEANS FOR NEUTRALIZING SELF-INDUCTION IN ALTERNATING CIRCUITS; E. Thomson and E. W. Rice, Jr., Swampscott, Mass. Application filed Sept. 1, 1893. The combination of a transformer and a condenser in circuit with a separate winding on the same core with the primary and secondary windings of the transformer and adapted to neutralize the lag of the current in the circuits to which the transformer is connected.

513,350. AUTOMATIC RHEOSTAT; B. C. Van Emon, San Francisco, Cal. Application filed April 4, 1893. A rheostat whose lever is controlled by a reciprocating piston, the cylinder of which is supplied with pressure by the motor.

513,352. ANNUNCIATOR SYSTEM; A. L. Vogt, Delaware, Ohio. Application filed March 8, 1893. An annunciator cabinet having push buttons which make contact with the proper circuits, terminating in an inner wall.

513,364. APPARATUS FOR REGISTERING TELEPHONE CALLS; L. Kahn, Hamburg, Germany. Application filed March 2, 1893. An apparatus for registering telephone calls, consisting of a transmitter for producing currents of alternate polarity to operate a printing telegraph at a distant station from the call station.

513,370. METHOD OF AND APPARATUS FOR PREVENTING PHASE DISPLACEMENT IN ALTERNATING CURRENTS; C. P. Steinmetz, Lynn, Mass. Application filed Sept. 9, 1893. The combination in an alternate circuit of a condenser connected inductively to the circuit through conductors carrying currents respectively proportional to the potential and current strength in the main circuit.

513,376. RAILWAY SIGNALLING APPARATUS; E. A. Winterhalder, Kappel, Germany. Application filed Dec. 3, 1892. In a block signalling apparatus, two symmetrically arranged electrically operated mechanisms driving two endless chains intermittently for the purpose of exhibiting colored discs, and a mechanical device operated by the train to remove the discs out of sight.

513,387. ELECTRIC BELT; W. C. Fuller, Salina, Kan. Application filed Oct. 11, 1893. In a belt, the combination of battery cells open at one end, a renewable inner element and surrounding absorbent packing adapted to be inclosed within a casing.

513,391. ELECTRIC METER; C. Gudgell, Independence, Mo. Application filed June 21, 1892. This comprises a solenoid having a movable core, a number of cumulative weights connected to a flexible attachment which is also connected to the movable core, an indicating train, and a wheel mounted in the train and engaged by the flexible attachment.

513,401. ELECTRIC MOTOR FOR STREET CARS; B. G. Lamme, Pittsburg, Pa. Application filed March 27, 1893. This comprises an armature mounted upon the axle of the car, and two field magnets independently sleeved upon the axle and suspended at their rear ends from the car body.

513,420. METHOD OF COOLING THE IRON OF TRANSFORMERS; H. A. Rowland, Baltimore, Md. Application filed Feb. 8, 1893. The combination with laminated iron sheets subjected to varying magnetic influences, of vessels containing fluid in juxtaposition to the sheets and parallel to the motion of the lines of force.

513,421. METHOD OF COOLING TRANSFORMERS; H. A. Rowland, Baltimore, Md. Application filed Feb. 8, 1893. The combination of a closed vessel, a volatile liquid partly filling the vessel, and a transformer immersed in the volatile liquid.

513,422. MEANS FOR COOLING ELECTRIC CONDUCTORS; H. A. Rowland, Baltimore, Md. Application filed Feb. 14, 1893. This consists in cooling hollow conductors carrying electric currents by passing a conducting fluid through the conductors and in breaking the electrical continuity of the fluid before it reaches and after it leaves the conductors.

513,425. SELF-INDUCTION COIL; C. F. Scott, Pittsburg, Pa. Application filed Nov. 25, 1892. A laminated core for induction coils composed of plates having complete and incomplete iron circuits alternately.

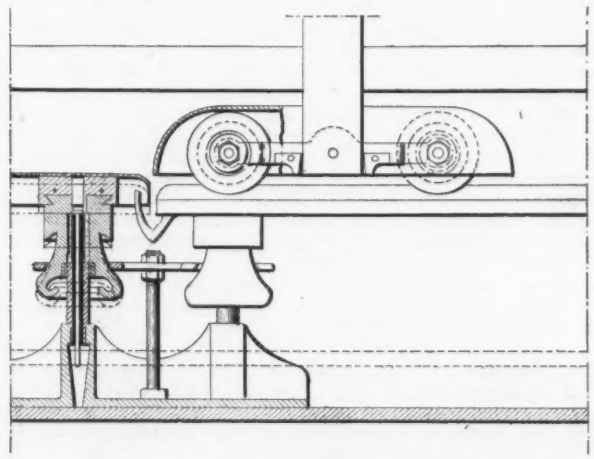
513,426. SPAN WIRE FOR OVERHEAD ELECTRIC RAILWAYS; S. H. Short, Cleveland, Ohio. Application filed April 1, 1890. The combination of parallel overhead line conductors, with span wires divided at one or more points between the conductors into two or more sections insulated from each other and from the ground.

513,440. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; H. S. Pruyn, Hoosic Falls, N. Y. Application filed Sept. 16, 1893. This comprises a main continuous conductor, a working sectional conductor, branch conductors from the main to the sectional conductor, spring mounted insulators supporting the sectional conductor, the insulators containing oil chambers.

513,457. RESISTANCE COIL; H. P. Davis, Pittsburg, Pa. Application filed April 22, 1893. In a resistance coil, a spiral strip of resisting material, and mica strips interposed between the convolutions thereof.

513,459. DYNAMO-ELECTRIC MACHINE; G. F. Dieckmann, Chicago, Ill. Application filed Dec. 23, 1892. The combination with the field magnet and its armature helix of a supplemental coil mounted separately from but located parallel to the helix and inductively influenced thereby.

513,460. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; H. L. Fee, New Orleans, La. Application filed July 26, 1893. The combination with the radial arms of a commutator of detachable



No. 513,440.—SUPPLY SYSTEM FOR ELECTRIC RAILWAYS.

insulating thimbles which are applied to the free ends of the arms and surround the same.

513,466. ELECTRICAL MEANS FOR PROPELLING CANAL-BOATS; J. Sachs, New York, N. Y. Application filed Feb. 15, 1893. The combination of a carriage movable along a support near the waterway, a motor on the carriage, means for connecting the carriage and boat, and a controlling device of the boat for the motor on the carriage.

513,469. ELECTRIC CLOCK SYSTEM; J. H. Gregory and Frederick Schmidt, Brooklyn, N. Y. Application filed May 16, 1893. The combination with a clock of an electric motor and train of gears, a controlling disc and armature lever, the disc having springs.

Copies of the specifications and drawings complete of any patent mentioned in this record---or of any other patent issued since 1886---can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, New York.